UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

7/6/2011

Matthew A. Love
Manager-Regulatory Affairs
Exide Corporation
3000 Montrose Avenue
Reading, PA 19605

REPLY TO THE ATTENTION OF:

US EPA RECORDS CENTER REGION 5
1003153

Pre-Final Corrective Measures Design Work Plan
Refined Metals Corporation
IND 000 718 130

Dear Mr. Love:

The United States Environmental Protection Agency (U.S. EPA) has completed the review of the Response to Comments for the Final Corrective Measure Design (Final CM Design) for the Refined Metals Corporation (RMC) facility located in Beech Grove, Indiana.

On January 4, 2011, EPA provided you with a conditional approval with the hope that RMC would be able to address all of EPA's comments. Also on May 3, 2011, EPA provided you with a second conditional approval. Based on our reviews, some of the EPA's comments are still not been properly addressed. Although the QAPP provides additional detail, it does not provide the level of detail required by the *EPA Requirements for Quality Assurance Project Plans*, dated March 2001 (EPA QA/R-5). For example, key elements of QA/R-5 are missing including sample rationale and laboratory standard operating procedures (SOPs). Further, the data validation discussion and checklists are insufficiently detailed. The enclosed attachment describes certain deficiencies noted in your latest submittals. Again, EPA is not opposed to RMC commencing work at the facility as long as the attached EPA comments are addressed within 14 days of receipt of this letter. The revised texts should be submitted within 14 days of receipt of this letter. If you have any questions, I can be reached at (312) 886-7954.

Sincerely,

Jonathan Adenuga
Corrective Action Section
Enforcement Compliance Assurance Branch

cc: Bradley Martin, Techlaw Inc.,
cc: Ruth Jean, IDEM

Evaluation of Response to GC 1b: The response does not address the comment. The data quality objectives (DQOs) discussed in Section 1.4 of the QAPP do not provide sufficient detail when compared to EPA's DQO guidance document, *Guidance on Systematic Planning using the Data Quality Objectives Process* (QA/G-4), dated February 2006 and EPA QA/R-5, Section 3.2.7, A7 - Quality Objectives and Criteria. The DQO section should clearly define the problem and the environmental questions that will be answered for the current investigation, including the previous data that has been collected for the site. Project decision "If..., then..." statements should be included, linking data results with possible actions. The DQOs should also identify the type, quantity, and quality of data needed to answer the study questions. Although some of this information may be located in the CM Design (e.g., the if/then statements for confirmatory sampling and the specific cleanup criteria for backfill included in Appendix A), this information should be added to the QAPP and summarized in a table to make the QAPP a more useful field document. Revise the QAPP to contain detailed DQOs to ensure that the environmental problems are adequately addressed and informed decisions can be made in the field.

Evaluation of Response to GC 1c: The response does not address the comment. The response indicates that certain sections in the SAP contain the rationale for the design of the proposed soil and groundwater sampling. However, the referenced sections do not appear to contain sufficient information and instead reference other pieces of the CM Design. The following are several examples where additional information is necessary:

a. The response indicates that Section 5.3 of the SAP contains the rationale for the stockpile sampling, but this section references the CM Design for the rationale and design. It is unclear where in the CM Design this information may be found (i.e., why collecting one composite sample of four aliquots per 250 cubic yards will sufficiently determine that metals concentrations are below cleanup criteria). Revise the QAPP to justify why this amount of sampling is sufficient to meet project goals.
b. The response states that the rationale for the containment cell groundwater sampling is provided in Section 5.6 of the SAP, but this section references Section 5.5.1 of the CM Design Report and Sections 2.6 and 4.2 of the Operations and Maintenance Plan. However, neither of these sections indicates why the proposed number and location of wells is sufficient to detect a release from the containment cell. Additionally, it is unclear why quarterly sampling for two years followed by semi-annual sampling for two years and then annual sampling was selected for the monitoring frequency. Revise the QAPP to justify why the proposed sampling is sufficient to meet project goals.
c. The design and rationale for the confirmatory sampling references Chapter 6 of the IDEM RISC Technical Guide (RISC Guide); however, additional detail is necessary to justify the sampling approach. Section 6.3 of the RISC Guide explains that random soil sampling for closure should consider the coefficient of variation (CV), and notes that additional samples or additional actions may be required if the CV is greater than 1.2. Additionally, Section 6.3.1 of the RISC Guide indicates that the upper confidence level (UCL) of the average concentration is used to determine closure. It is unclear if this statistical approach will be used for determining if additional excavation is

ATTACHMENT

Evaluation of Response to General Comment (GC) 1a: The response partially addresses the comment. However, key elements of *EPA Requirements for Quality Assurance Project Plans*, dated March 2001 (EPA QA/R-5) have not been addressed in the QAPP. For example, the Quality Assurance Project Plan (QAPP) does not contain all standard operating procedures (SOPs) that will be used (e.g., for validation, analysis, etc.). Further, some of the information presented in the QAPP is inconsistent with the information presented in the SAP and other sections of the CM Design. The following are examples of deficiencies and inconsistencies noted in the QAPP:

a. Section 4.2 of the QAPP, entitled Verification and Validation Methods, does not contain all of the qualifiers presented in SAP Section 10.2, Data Validation Protocol. Revise the QAPP and/or SAP to address this discrepancy.
b. Section 4.2 of the QAPP cites one SOP for data validation, while Section 10.2 of the SAP references two procedures. Revise the QAPP and/or SAP to address this discrepancy.
c. Section 4.2 of the QAPP indicates that the Treatment System sample delivery groups (SDGs) will undergo a lesser quality assurance (QA) review, but this has not been discussed in the SAP. It is also unclear what SDGs this refers to and why a lesser QA review was selected. Revise the QAPP to address this discrepancy.
d. Table 2, Data Quality Objectives, in the QAPP lists a relative percent difference (RPD) of 35 percent for matrix spike soil samples, but the method specified limit included in Table 12-1 of Attachment A, the Laboratory Quality Assurance Manual, is 20 percent. Revise the QAPP to address this discrepancy.
e. The QAPP does not discuss and summarize the secondary data that was used for the project; however, Appendix A, Confirmatory Sampling, indicates that previously collected data was used. Revise the QAPP to summarize previously collected data, including any limitations on this data.
f. The QAPP does not indicate whether soil samples will be reported on a dry weight basis and if criteria objectives listed in Table 1, Sampling Parameters and Reporting Limits, are dry weight corrected. Revise the QAPP to indicate that both soil results and project criteria objectives will be reported based on dry weight.
g. The QAPP includes extraneous information regarding analyses and validation of organic methods, but the SAP indicates only inorganic analyses will be performed. For example, Section 2.4 of the QAPP indicates tentatively identified compounds (TICs) may be measured, Section 4.2 of the QAPP discusses QA review of organic data, and data validation checklists are provided for semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs). Revise the QAPP to remove extraneous information.

Revise the QAPP to provide all SOPs referenced in the QAPP. Also, ensure the QAPP, SAP and CM Design present consistent information. Additional examples of missing EPA QA/R-5 elements are also included in the following comments.

required or if closure is complete. Revise the QAPP to explain the rationale for the confirmatory sampling approach in greater detail.

Evaluation of Response to GC 1d: The response and information presented in Attachment B of the QAPP does not address the comment. The data validation checklists provided as Attachment B of the QAPP do not include the acceptance limits that will be used to validate data or how/when the associated qualifiers will be used when exceedances of control limits occur. Revise the QAPP to either indicate that the EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review will be used as written (i.e., not modified for SW-846 method) or provide a checklist that includes details on how samples will be qualified (e.g., the control limits and associated qualifiers for exceedances that will be used during data validation).

Evaluation of Response to GC 1e: The response appears adequate; however this information should be added to Section 1.6, Documents and Records, of the QAPP. Additionally, Section 1.6 should include the monthly reports discussed in QAPP Section 3.2, Reports to Management. Revise Section 1.6 of the QAPP to include the information discussed in this response and the monthly reports discussed in Section 3.2.

Evaluation of Response to Specific Comment (SC) 3: The response partially addresses the comment. The response indicates that the long, narrow excavations ND1 and ND2 will be sampled along the centerline of the removed soil. However, it is unclear what will be done to minimize clustering of sampling locations for these narrow excavations. For example, the three sample locations for ND1 could be preferentially located at one end of the excavation. To ensure sample locations are sufficient, the proposed sample locations on the grids should be depicted. Revise the SAP to include the proposed locations of the confirmatory samples.

Evaluation of Response to SC 14: The response addresses the comment; however, the addition of dissolved oxygen (DO) and oxygen reduction potential (ORP) to well stabilization parameters in Section 2.2.4.3 of the QAPP should also be made to Section 6.6.3 of the SAP. Revise this section of the SAP to include the well stabilization parameters provided in the QAPP.

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October 6, 2010 2003-1046-00

Mr. Jonathan Adenuga
Corrective Action Section
USEPA Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3590

RE: Response to Comments
Pre-Final Corrective Measure Design
Refined Metals Corporation
IND 000 718 130

Dear Jonathan:

Refined Metals Corporation (RMC) has received and reviewed the comment letter on the Pre-Final Corrective Measure Design from the United States Environmental Protection Agency (USEPA) for the RMC facility in Beech Grove, Indiana. Advanced GeoServices has prepared the following responses to those comments and completed corresponding changes to the Pre-Final Corrective Measure Design. Three (3) copies of the Final Corrective Measures Design are provided for your review.

USEPA COMMENTS

Comment: 1. Section 4.4.2, Surface Soil, Page 4-3: Revise this section to discuss BHHRA results with respect to antimony, cadmium and selenium, which have been added as Contaminants of Concern (COCs) in the Design Report or provide the reasons for their addition as COCs.

Response: The BHHRA did not assess antimony, cadmium and selenium because they were not retained as Constituents of Concern (COCs) for those portions of the site subject to Corrective Measure (I.E., this area of the site outside the boundaries of the Hazardous Waste Management Units). Antimony, cadmium and selenium were retained for the Hazardous Waste Management Units (HWMUs) only, which are being closed utilizing their corresponding Indiana Department of Environmental Management (IDEM) RISC Industrial Default Closure values.

Section 4.1.1 provides a discussion regarding the elimination of barium, cadmium, chromium, mercury, selenium and silver as constituents of concern (COCs) in the Corrective Measure areas based on the results of the Phase I RFI. We have added a sentence that Phase II RFI, BHHRA and CMS completed for the corrective measures activities were exclusively for lead and arsenic.

Comment: 2. Section 1.2, Background, Page 1-2: This section states, "A summary report of the decontamination and demolition activities is being prepared on a parallel track with preparation of this CM Design submission and will be included as an attachment to the Corrective Measures Completion Report to be provided following completion of the Corrective Measures." It is noted that this and other text have been added to this section. Revise this section to indicate that the summary report will describe the specific methods used to decontaminate the buildings prior to demolition, the types of waste that were generated during the remedial activities, and how this material was handled and disposed. In addition, ensure that the text of this section indicates that the summary report will describe the procedures that were followed during the decontamination of the pump houses, including a summary of any confirmatory sampling results. Finally, revise the discussion in Section 2.1, Facility Location, to reflect the changes made to Section 1.2.

Response: The summary report of the decontamination and demolition activities will provide the requested information. Regarding decontamination of the pump houses, as discussed during our conference call on July 20, 2010, the pump houses remain operational and will remain in operation until demolition of the pump houses as part of the Corrective Measures Implementation. We have added text indicating that accumulated sediment was removed from the storm water inlets/manholes, piping system and pump house sumps during the final stages of the decontamination and demolition activities. We have also modified the text in Section 1.2 to more clearly state that following the proposed corrective measures and closure activities, the existing storm water collection and pumping system will no longer be used.

Comment: 3. Section 5.4, Containment Cell, Page 5-4: This section states, "The specific materials to be utilized for the cap will be determined based upon slope stability calculations in the final configuration of the cap." However, it was not clear why this information was not presented in this Design Report. Please revise the Design Report to address this issue.

Response: The slope stability calculations have been performed and are provided in Attachment C. The specifications identify the types of material and the minimum required strength and interface friction values.

Comment: 4. Section 5.5.2, Pg. 5-7, MNA groundwater Monitoring: As described in the text, the frame work for the MNA has some shortcomings and does not comport with what EPA requested in the final Decision and Response to comments for the selection of Remedial Alternatives:

The section indicates that new groundwater monitoring well CC-4 will be used as a surrogate well for abandoned monitoring wells MW-7 and MW-10; however, justification for monitoring well CC-4 being appropriate for evaluating contamination previously noted at wells MW-7 and MW-10 was not included. Revise the Design Report to include information on the Monitored Natural Attenuation (MNA) monitoring well locations and their appropriateness for assessing conditions at the site;

The section indicates that chemical analysis will be performed on soil samples from the newly installed monitoring wells CC-1 – CC-4, however, the number and depth of samples were not specified and the purpose of these data and how these results would be evaluated was not clear. Revise this section to include more details on the proposed soil sampling. The statement "sampling and evaluation of data being performed in relation to MNA of lead and arsenic in groundwater are considered components of RCRA corrective measures" is somewhat unclear and needs further clarification.

We have included in this Attachment, a September 2000 Memorandum titled "Transmittal of Monitored Natural Attenuation Framework". We recommend that you use some of the strategies described in this MNA framework to help you in developing an adequate MNA plan.

Response: A detailed MNA Work Plan has been prepared and attached to the Corrective Measures Design Report as Attachment H. The MNA Work Plan provides the level of detail necessary to define, implement and interpret the MNA activities. The proposed MNA network includes a combination of existing and proposed wells are screened within the shallow perched groundwater zone. The MNA Work Plan also specifies the completion of geotechnical, geochemical and aquifer testing as part of the installation of proposed wells. We have provided additional information regarding the horizons to be targeted for sample collection and analysis.

Comment: 5. **Section 6.3, Pg. 6-6, Containment Cell Construction: As indicated in this text, there appears to be some discrepancies in the groundwater elevation at the site. The discrepancies in the current groundwater elevation and the proposed bottom elevation of the Containment Cell would result in a Bath-tub effect. This is an important issue that must be resolved ahead of any development of the Containment Cell construction details. RMC must submit to EPA evidence that the groundwater elevation issues are adequately addressed prior to approval of the Containment Cell construction details.**

Response: During preparation of this response, the RMC site topography was resurveyed by an Indiana Licensed Professional Surveyor and correlated to the same datum (NGVD 29) previously utilized for establishing groundwater elevations. This is the same surveyor responsible for locating (vertically and horizontally) the groundwater monitoring wells during the RFI. The topography for off-site areas has also been update using 2003 topographic information obtained from the City of Indianapolis which is also tied to NGVD 29. The design drawings have been revised to depict the updated survey information, and provide revised proposed grading.

A review of groundwater records shows that MW-10 was installed during September 2003. Since installation, 18 depth to water measurements have been obtained from MW-10, including quarterly measurements since fall 2007. The highest observed groundwater elevation at MW-10 was 841.25 (April 2005). The lowest observed groundwater elevation was 833.24 (October 2007). Measurements indicate higher groundwater levels in the spring (average elevation for measurements obtained during January through June = 840.26) and lower groundwater levels in the fall (average elevation for measurements obtained during July through December = 836.83). As shown on Sheet 5 of the Design Drawings, the proposed cell will have a bottom elevation of 841.5. Restoration grading around the proposed containment cell will include constructing a perimeter drainage swale with invert elevations below elevation 839.0 and the proposed storm water management basin east of the containment cell will have an overflow established at 840.0. The proposed improvements are deigned to eliminate the poor drainage conditions that currently characterize the northwest area on the RMC site. The enhanced surface water drainage conditions, in conjunction with the elimination of any significant infiltration beneath the containment cell cap will combine to help ensure that groundwater surface elevations, even during seasonally high periods do not rise above the bottom of the cell and create a "bath-tub effect".

Comment: 6. Section 6.3, Pg. 6-7: The text states that MW-2s, MW-2D, MW-7 and MW-10 will be abandoned prior to the start of construction of the Containment Cell. However, monitoring wells CC1 through CC4 proposed specifically for monitoring the effectiveness of the Cell are insufficient. Based on the size of the Containment Cell, the numbers of proposed wells (CC1-CC4) are insufficient to monitor the entire circumference of the Containment Cell. The number of monitoring wells must be increased especially on the eastern, western and southern portions of the Containment Cell.

Also, this section indicates that existing groundwater monitoring wells MW-2s, and 2D, MW-7 and MW-10 will be abandoned by Refined Metals prior to the start of the construction of the containment cell. Only well MW-10 is visible on the current version of Sheet 5, Containment Cell Construction, Filling and Capping Plan. In addition, Sheet 5 of the Preliminary Design Report indicates that well MW-2, not MW-2s will be abandoned. Revise this section to correctly reference well MW-2 and not MW-2s. Also, revise Sheet 5 to indicate the locations of all four wells that will be abandoned. Finally, revise this section to describe the procedures that will be followed during the abandonment of the four wells as requested by Specific Comment 14 on the Preliminary Design and

This section indicates that materials with a total lead concentration greater than the calculated Preliminary Remediation Goal (PRG) of 920 milligrams per kilogram (mg/kg) will be placed in the containment cell, but does not indicate the proposed analytical method or sampling frequency that will be used to collect and analyze the samples. In addition, this section indicates that materials with total lead concentrations less than 400 mg/kg will be approved for unrestricted use throughout the site. Revise this section to indicate the proposed analytical method and sampling frequency that will be used to collect and analyze the materials for lead as requested by Specific Comment 15 on the Preliminary Design Report, and to discuss why materials with total lead concentrations of less than 400 mg/kg will be approved for unrestricted use on the site.

Response: The proposed groundwater monitoring well network has been revised to include six new wells and retains existing shallow well MW-2 as shown on Sheet 5. The configuration has been developed based on previous depth to groundwater information gathered from MW-2, MW-7 and MW-10 which shows a shallow perched zone in the vicinity of the proposed containment cell dominated by a west to east flow pattern. As proposed, those wells along the western boundary of the cell (MW-2, CC-1, and CC-2) are expected to represent upgradient groundwater conditions but will also confirm that flow remains in a west to east direction beneath the footprint of the cell; CC-3 is expected to function as an upgradient/cross-gradient well, but would also act as a downgradient well if groundwater flow posses' a northern or northeasterly component; and CC-4, CC-5 and CC-6 provide monitoring along the east side.

The graphics on Sheet 5 have been fixed to prevent the shading from covering the wells proposed to be abandoned. Note that neither MW-2 nor MW-2D are now proposed for abandonment. Permanent abandonment of groundwater monitoring wells MW-7 and MW-10, and permanent abandonment of the former facility production well shall be in accordance with the requirements established in 312 Indiana Administrative Code 13-10 (Rule 10). Rule 10 requires that abandonment activities be performed by a water well driller using a neat cement, bentonite slurry, or crushed or pelletized bentonite. Notification of abandonment will be filed by the well driller within 30 days following completion of plugging activities. Monitoring well installation will be performed in accordance with the procedures contained in the RFI Work Plan.

General procedures for stockpile sampling have been added to Specification. We have also limited the maximum stockpile size to 500 cubic yards. Stockpile samples will be analyzed for lead, arsenic, antimony, cadmium and selenium (Method 6010). Analytical results for arsenic, antimony, cadmium and selenium will be compared against the soil standards listed for HWMU Closure in Section 5.3 of the CM Design Report. Lead will be compared against the 920 mg/kg PRG calculated by the BHHRA and the 400 mg/kg residential soil screening value being used for lead in soil within the public and railroad right of way. Stockpiles with results below the HWMU soil standards for arsenic, antimony, cadmium and selenium and less than 400 mg/kg lead can be utilized as backfill anywhere on-site. Stockpiles with results below the HWMU soil standards for arsenic, antimony, cadmium and selenium and between 400 mg/kg and 920 mg/kg total lead can be utilized as backfill anywhere on-site except within drainage features and the storm water management basin. Stockpiles with results that exceed the HWMU soil standards for arsenic, antimony, cadmium and selenium or have >920 mg/kg lead will be placed in the containment cell or sent off-site for disposal.

Comment: 7. **Sections 6.4.2.1, 6.4.2.2, Pg. 6-10 and Section 02210: These sections deal with materials for use in excavation backfill and for placement in the onsite Containment Cell. The terms Granular fill, Structural Soil and General Site fill as defined in Section 02210 are somewhat**

confusing and does not comport with how these materials are proposed for use in sections 6.4.2.1 and 6.4.2.2. Firstly, Granular fill (crushed stone) as defined in section 02210 will only be used for backfill beneath the water table. However, the text also states that contaminated crushed concrete retrieved from the RMC facility will also be used as backfill material beneath the water table. It is not clear if RMC is implying that imported clean crushed stone is the same as crushed contaminated concrete retrieved from the site. Also, RMC needs to explain the engineering method they intend to use in order to place crushed contaminated concrete beneath the water table at the site.

Secondly, Structural fill as defined in Section 02210 is to be free of organic mater, debris, roots e.t.c. However, the text also states that crushed contaminated concrete/asphalt, and unrestricted fill material (structural fill) will be used as in excavation backfill. It is unclear what is meant by unrestricted fill material. Also asphalt contains organic matter. Therefore, it contradicts the definition of Structural fill as defined above. Also, this section indicates that the crushed concrete and asphalt will be sampled, but does not describe what level of contamination in the crushed concrete and asphalt would be deemed acceptable for use as backfill.

A distinction between materials to be used in excavation backfill and those placed in the onsite Containment Cell must be clearly and unambiguously established. For the purpose of clarity, materials to be used in excavation backfill must be clean imported materials. EPA will not oppose the placement of crushed Concrete/Asphalt in the onsite Containment Cell, providing these materials do not compromise the integrity of the Containment Cell cover.

Response: The text provided in the report and in the Specifications has been revised to provide additional clarity. The text in Section 6.4.2.1 has been revised to indicate that the removed asphalt will be segregated for placement in the containment cell. Crushed concrete stockpiles will be sampled following the same protocol and analytical methods utilized for soil stockpiles. The engineering method to place any crushed concrete is the same as that for granular fill which is specified in 02210, Section 3.5

Material utilized for backfill and site restoration will come from one of three possible sources. They are as follows:

a. Analytical results for arsenic, antimony, cadmium and selenium will be compared against the soil standards listed for HWMU Closure in Section 5.3 of the CM Design Report. Lead will be compared against the 920 mg/kg PRG calculated by the BHHRA and the 400 mg/kg residential soil screening value being used for lead in soil within the public and railroad right of way. Stockpiles with results below the HWMU soil standards for arsenic, antimony, cadmium and selenium and less than 400 mg/kg lead can be utilized as backfill anywhere on-site. Stockpiles with results below the HWMU soil standards for arsenic, antimony, cadmium and selenium and between 400 mg/kg and 920 mg/kg total lead can be utilized as backfill anywhere on-site except within drainage features and the storm water management basin. Stockpiles with results that exceed the HWMU soil standards for arsenic, antimony, cadmium and selenium or have >920 mg/kg lead will be placed in the containment cell or sent off-site for disposal.

b. Soil and crushed stone imported from off-site sources.

c. Soil generated on-site during cutting/filling operations after completion of proposed soil remediation.

Comment: 8. Section 6.4.2.1, Pg. 6-10, Para. 3: The statement regarding side wall sampling at HWMU boundaries is somewhat convoluted. The text's artificial reference to some different standards for closure versus corrective action needs to be further explained. Regardless of this obscure standard, confirmatory sampling of all sidewalls should be performed using the appropriate standard.

Response: The reviewer's comment about an "artificial reference to some different standards" is unclear. Sections 1.3 "Purpose" and Section 3.0 "Regulatory Purview" of the Corrective Measures Design Report provide detailed information about the separation of Hazardous Waste Management Unit (HWMU) Closure under IDEM from site wide Corrective Measures under USEPA. The separation of responsibility is a requirement of the Consent Decree (Section VI, Paragraph 37). Section 1.3.5 "Corrective Measures Design" discusses the agreement between USEPA, IDEM and RMC to include the Closure activities as a component of the Corrective Measures Design.

Sections 5.2 and 5.3 of the Corrective Measures Design Report discuss the use of separate standards, and present the applicable standards, for those areas subject to corrective measures versus those areas subject to Closure. We have attempted to further clarify the dual standards in Section 6.4.2.1. Regardless, sidewall sampling is only proposed and only necessary to demonstrate attainment of the remediation standards within the HWMUs.

Comment: 9. Section 6.4.2.1, Outdoor Waste Pile, Pg. 6-11, Para. 1: Text states that following approval of confirmatory sampling by the Engineer, the resulting excavation will be backfilled. RMC needs to explain what confirmatory sampling the Engineer is providing. Attachment A implies that confirmation would be based on analytical data (XRF and laboratory analysis). Attachment D also seemed to imply that post excavation confirmation sampling will be implemented by the QA. It follows that the Engineer can only confirm the elevation of excavation and not the actual laboratory chemical analysis. Therefore, all post excavation confirmatory sampling must have documented laboratory results prior to backfilling.

Response: To provide consistency with the Construction Quality Assurance Plan, the referenced text has been modified to indicate that the confirmatory sampling is being performed by the QA Representative and not the Engineer. In addition, as stated in Appendix A of the Construction Quality Assurance Plan (Attachment D) the acceptability of the remedial efforts is being determined through a combination of XRF and laboratory analysis.

Comment: 10. Section 6.5, On-Site Corrective Measures, Page 6-13: This section contains a reference to Remedial Action Levels (RALs) that conflicts with information presented on Page 6 of the Statement of Basis. The second sentence of this section states "Non-HWMU soil excavation areas included the former manufacturing area (referred to as the "on-site area" in the BHHRA), lawn and wooded area (referred to "grassy area" in the BHHRA) of the Site that are outside of the HWMUs and exceed the calculated RALs of 4,954 and 8,470 mg/kg total lead, respectively." The RALs listed at the bottom of Page 6 in the Statement of Basis, however, indicate an RAL of 4,954 mg/kg for the onsite grassy areas. Revise this section to resolve this discrepancy.

Response: The BHHRA uses several terms ("Facility Area", "On-Site Area", and "On-Site Main Facility Area.") We utilized "former manufacturing area" with a parenthetical to "on-site main facility area" to describe the subject area because we felt it was most descriptive and merged the terminology contained in the Statement of Basis with the terminology used in the BHHRA.

Comment: 11. Section 6.6, Offsite Corrective Measures: The Design Report does not include a sufficient discussion of the implementation of a deed restriction on the Citizen's Gas property. Such a discussion was required by the Final Decision. Revise the Design Report to include a discussion of implementation of the deed restriction for the Citizen's Gas property, as required by the Final Decision. In addition, revise the Design Report to discuss in more detail the onsite deed restrictions that will be implemented. Ensure that the Design Report discusses the placement of institutional controls to restrict the use of the property to only commercial/industrial land use, and a deed restriction preventing the installation of onsite potable groundwater wells that are required by the Final Decision.

Response: The requested discussion of a deed restriction for the Citizens Gas property has been added as new Section 6.3 to the final corrective measure design.

The requested discussion of a deed restriction for the site has been added as new Section 6.9 to the final corrective Measure Design.

Comment: 12. Attachment B, Construction Specifications, Section 02210, Earthwork, Part 2, Products, Section 2.1, Structural Soil Fill, Page 02210-3: This section indicates that structural soil fill will be analyzed for antimony, arsenic, cadmium, lead and selenium but does not specify the proposed analytical method. Revise this section to indicate the proposed analytical method. In addition, include a discussion justifying why sampling for Volatile Organic Compounds (VOCs) and Semi-volatile Organic Compounds (SVOCs) is not proposed for structural Soil Fill.

Response: The specification section as written does require analysis of imported Structural Soil Fill for TCL VOCs and SVOCs. We have added a reference to the required analytical methods to be utilized by the Contractor for Structural Soil Fill, Cap Soil Fill and Granular Fill.

Comment 13. Attachment B, Construction Specifications, Section 02210, Earthwork, Part 2, Products, Section 2.2, General Soil Fill, Page 02210-3: This section indicates that general site fill will not require analytical testing prior to use as fill, but does not justify this conclusion. The first two sentences of this section state "Following completion of proposed remediation and receipt of acceptable confirmatory sampling results, the Contractor may cut into areas

protruding above the proposed subgrade for final grading and utilize cut materials as fill in low areas. The cut material will be considered General Site Fill and must meet the general geotechnical requirements for structural soil fill and be approved by the QA Representative but will not require analytical testing." Revise this section to provide justification for the conclusion that general fills will not require analytical testing.

Response: The referenced text has been expanded to state that the General Facility does not require analysis because it will have already been demonstrated to be clean based on the result of the required confirmatory sampling. We have also expanded the paragraph to allow the use of soil cut from completed corrective measures excavation areas as fill in the closure areas if the confirmatory sampling includes the analysis for arsenic, antimony, cadmium ad selenium (in addition to lead) and those results can demonstrate that the area meets the requirements for HWMU Closure.

Comment 14. Attachment D, Construction Quality Assurance Plan, Appendix A, Confirmatory Sampling, Page A-4: This section does not describe the proposed confirmatory sampling plan. The last sentence of the second paragraph of this page states "Sheet 7 of the design drawings and the actual locations will be determined randomly utilizing a 10 foot by 10 foot grid superimposed over the excavation area." Revise this section to discuss how many samples will be collected from each 10 foot by 10 foot grid.

In addition, this section discusses sending 20 percent of X-Ray Fluorescence (XRF) screened soil samples for laboratory analysis, and developing a correction factor based on field XRF and laboratory results, but does not describe the limits of acceptable correlation between field XRF and laboratory analysis. Revise this section to discuss the acceptable range of correlation between field XRF and laboratory analysis and to indicate the specific analytical method that will be used by the laboratory.

Response: Attachment D, Construction Quality Assurance Plan, Appendix A, Confirmatory Sampling, provides the confirmatory sampling requirements. We have expanded this section to provide additional detail. The tables presented on Sheets 7 and 8 have been expanded to indicate the number of sample grids that must be sampled to provide adequate statistical coverage of the excavation area. We have also added language stating that for the XRF analysis to be considered acceptable for use, the comparison of the laboratory and XRF results must achieve a coefficient of determination (r^2) equal to or greater than 0.70.

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

ENGINEERING COMMENTS

The Engineering Section has reviewed the Draft Preliminary Corrective Measures Design for Refined Metals in Beach Grove, Indiana. The current report does not contain significant material for an engineering approval.

Comment 1. Provide the following detailed calculations showing that this cell is designed properly:
- **a. Slope stability calculations**
- **b. Soil erosion calculations (e.g., RUSLE)**

Response: Additional Engineering calculations have been provided in Appendix C of the Corrective Measures Design.

Comment 2. Section 6.3 Containment Cell Construction – Revise the drawings to Show the minimum 3% slope of the top of the cell. If necessary, provide the contours on the top of the cell at 1 foot intervals.

Response: A "minimum grading" configuration has been added to Sheet 5 of the design drawings.

Comment 3. Closure Cost-estimates – Include the following cost:
- **a. Closure Certification**
- **b. Contingency Allowance (20% recommended by EPA Cost Pro)**

Response: The Closure Cost - Estimate has been revised to include a separate line item for the closure certification and the contingency has been increased to 20%.

OLQ Chemistry Services Section – Science Services Branch

1. In Appendix A Section 2.3, Hazardous Waste Management Units, the consultant proposes closure sampling based on XRF, a screening instrument, after correlations with laboratory results of 20% of the samples. This section states that laboratory results will be evaluated against the corresponding average XRF concentration and a correction factor (regression equation) will be developed for each parameter. It should be noted that a minimal acceptable regression

(r^2) would be 0.821. Due to relative large number of samples, this procedure is acceptable if the minimum acceptable r^2 = 0.821. If this correlation is not achieved than another 10% of the samples will need to be analyzed. If the correlation is still not achieved, then all samples will need to be analyzed.

Response: USEPA Method 6200 (Section 9.7) considers a direct comparison (i.e. uncorrected data) of XRF and laboratory results with a correlation coefficient (r) of 0.7 to 0.9 to be considered acceptable for screening level data and a correlation coefficient >0.9 to be considered statistically equivalent to a 99% UCL. We have expanded the text in Appendix A of the Construction Quality Assurance Plan to require that the unadjusted correlation coefficient be at least r = 0.837 (r^2 = 0.7). But because we are applying a correction factor to our results and then calculating a 95% UCL to the results this will actually result in a higher level of certainty that the representative value for the excavation area will be below the target remediation levels.

2. **Appendix D, Sampling and Analysis Plan, Section 6.5.3, Matrix Spike Samples, it is unclear if enough sample volume will be collected to perform a matrix spike/matrix spike duplicate analysis. The consultant should collect enough sample volume to perform a matrix spike and matrix spike duplicate.**

Response: We have revised the text in this section to indicate that both a Matrix Spike and a Matrix Spike Duplicate sample will be collected and analyzed. We have also added language requiring collection of a second sample volume from the same size and depth sample hole from immediately adjacent to parent sample. Both sample volumes will be composited in the same baggie and homogenized together, analyzed with the XRF and then be removed and placed in the laboratory supplied sample containers.

3. **Appendix D, Sampling and analysis Plan, Table 3, it states that samples from the HWMU, non-HWMU onsite areas, and offsite areas will be collected in zip lock baggies. Soil samples that will be sent to the laboratory for confirmation analysis should be collected in either a plastic or glass container provided by the laboratory. Table 3 should be amended to reflect this change.**

Response: The text has been revised to require placement of samples destined for laboratory analysis into sample containers provided by the laboratory.

We believe this addresses the comments raised on the Pre-Final Corrective Measure Design. In addition to incorporating the changes and edits described above we have also made addition edits to refine the design and provide additional detail.

If you have any questions, please call me at 610-840-9122.

Sincerely,

ADVANCED GEOSERVICES CORP.

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Matt Love, Exide Technologies (RMC) (1 copy)

[redacted] 15, 2009

EPA

BRIEFING

Final Decision and Response to comments for Selection of remedial Alternative for Refined Metals Corporation, Beech Grove, Indiana

BACKGROUND INFORMATION

Refined Metals Corporation is located at 3700 South Arlington Avenue in Marion County, Beech Grove, Indiana, approximately four miles south-southeast of downtown Indianapolis. In 1968, the property was developed as a secondary lead smelter by National Lead. National Lead operated the facility from 1968 through 1980, when it was sold to Exide Corporation. In 1985, the site was purchased from Exide Corporation by RMC. RMC continued to operate the facility until the cessation of operations on December 31, 1995. From April 14, 1995 through December 31, 1995, operations were reduced to enriching and casting lead ingots from off-specification lead products. Since 1996, no operations have taken place at the facility. Soil and groundwater in several areas at the facility are contaminated at levels above appropriately protective risk-based screening thresholds. Offsite contamination has also been reported north of the facility and in a drainage ditch east of the facility and at the adjacent Citizen's Gas Property west of the facility.

Remedial Alternative Selected

Following the conclusion of the facility investigations, a Statement of Basis was issued for public review and comment from June 27, 2008 to August 11, 2008. The Proposed remedies consisted of excavation of highly contaminated soils and sediments, incorporation of the excavated soils and sediments in an onsite Containment Cell, placement of institutional control on the facility and monitored natural attenuation. We received a number of written comments from the Citizens Gas Energy Group and the City of Beech Grove, Indiana. We have prepared responses to all these concerns and comments. In sum, one substantive change to the Statement of Basis was made. The proposed remedy was modified to address concerns regarding the location of the proposed Containment Cell. The attached Final Decision and Response to Comments describes in detail received comments, our responses and the selected remedy for the Refined Metals Corporation facility.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
FINAL DECISION AND RESPONSE TO COMMENTS
FOR SELECTION OF REMEDIAL ALTERNATIVE

FOR
REFINED METALS CORPORATION FACILITY
BEECH GROVE, INDIANA

September, 2009

FINAL DECISION AND RESPONSE TO COMMENTS
SELECTION OF FINAL REMEDIAL ALTERNATIVE
FOR
Refined Metals Corporation Facility
Beech Grove, Indiana

Introduction

This Final Decision and Response to Comments (FD/RC) is presented by the Environmental Protection Agency (EPA) for the Refined Metals Corporation (RMC) Facility located in Beech Grove, Indiana. The FD/RC includes, as Attachment I, the previously issued Statement of Basis. The Statement of Basis outlined potential remedial alternatives at the Facility as well as EPA's proposed remedy and was made available for public review and comment from June 27, 2008 to August 11, 2008. This FD/RC selects the final remedy to be implemented at the Refined Metals Corporation Facility based on the Administrative Record and public comments. EPA's Response to Comments addresses substantive comments received on the Statement of Basis during the 45 day public comment period.

Assessment of the Site

The response action documented in this FD/RC is necessary to protect human health and the environment.

Selected Remedy

EPA has selected the following remedial components as the remedy to address contaminated soil, groundwater and sediment at the Refined Metals Corporation Facility:

For lead in onsite soils and sediments, as well as offsite soils along the Arlington Avenue right-of-way, the railroad right-of-way, and the Big Four Road right-of-way, RMC will implement the following tasks as described in the Statement of Basis:

- Excavation of the most highly contaminated soils and sediments,
- Demolition of the Material Storage Building, Battery Breaker Building, Filter Press Building, Waste Water Treatment Building and Surface Impoundment, and
- Placement of institutional controls to restrict the use of the property to only commercial/industrial land use.

To assure safe and effective long-term management of the excavated soils and sediments as well as debris and rubble generated from the excavation and demolition, RMC will implement the following tasks as described in the Statement of Basis, except that the location of the Containment Cell has been changed:

- Construction of a Containment Cell that will be located in the northwest portion of the RMC property, north of the former operational area and parking areas, and west of the drainage ditch,
- Placement of excavated soils and sediments, as well as the debris and rubble from the building demolition in an onsite Containment Cell,
- Encapsulation of the excavated soils and sediments beneath an impermeable geomembrane cap covering the entire footprint of the Containment Cell and a vegetative cover above the geomembrane,
- Establishment of long-term operation, maintenance and groundwater monitoring of the Containment Cell including existing monitoring wells, and
- Placement of institutional controls on the Containment Cell to prevent any disturbance, excavation, or other activity that might result in a release of any materials contained in the cell.

To manage any excavated soils and sediments as well as any demolition debris or rubble that is not safely managed in the onsite containment cell, RMC will implement the following task:

- Shipment of these materials offsite to another facility for recycling or disposal in accordance with all applicable Federal, State and local regulations.

For Lead in soils at the offsite Citizens Gas property: The commercial/industrial cleanup standards are applicable to this property, and EPA agrees that no remediation is warranted provided that the future land use is restricted to commercial/industrial. Thus, the selection of this final remedy requires implementation of a deed restriction on the Citizens Gas property to ensure that its use is restricted to only commercial/industrial. Citizens Gas and RMC have reached an agreement regarding the land use restriction and the majority of comments raised by Citizens Gas on EPA's draft statement of basis have been rendered moot. Some construction work will be performed under this agreement between RMC and Citizens Gas, but independent of this final remedy.

For On-site Groundwater: To prevent human consumption of groundwater at the Facility, RMC will place a deed restriction preventing the installation of potable groundwater wells at the Facility. Institutional controls are also necessary to prohibit the use of shallow on-site groundwater as a drinking water source and restrict construction activities in on-site areas where humans may come in direct contact with shallow groundwater. In addition, Monitored Natural Attenuation (MNA) will be implemented as the principal means of restoring the on-site contaminated groundwater at the Facility. Monitored natural attenuation (MNA) is the stabilization and long-term shrinking of a contaminant plume by natural processes such as microbial degradation. The major component of MNA as a remedial alternative would be the long-term monitoring program to provide initial and continuing confirmation that the predicted biological activity and/or reductions in contaminant concentrations occur and remain effective. Monitored Natural Attenuation must demonstrate reduction or stabilization of lead within 10 years of this Final Decision. Within this reasonable time frame (10 years), we expect that monitored natural attenuation will restore the on-site groundwater such that it would be available for use as a source of commercial or residential drinking water.

Documents to be submitted:
RMC shall submit to EPA for review and approval within 60 days of this Final Decision a Corrective Measures Implementation (CMI) workplan for the excavation and off-site treatment/disposal, the building demolition, and the construction of the Containment Cell for lead contaminated soils and sediments. The design work consists of the design plans and specifications, proposed remediation objectives, construction cost estimate, construction quality assurance objectives, waste disposal requirements, project schedule, quality assurance project plan, Community Relations Plan, sampling and analysis plan, an air deposition management plan and health and safety plan. RMC shall implement the approved final design, incorporating EPA comments. Remedy construction must be completed within one year of this Final Decision, and a Construction Completion Report and O&M Plan must be submitted to EPA for review and approval at that time. In the report, a registered professional engineer and the RMC Project Manager shall certify that the remedy for lead-contaminated soils and sediments from these areas have been conducted in accordance with the EPA-approved final design and specifications, to the best of their knowledge, and cleanup objectives have been attained. The report shall include as-built drawings signed and stamped by a registered professional engineer. RMC must implement any approved final O&M Plan, incorporating EPA comments.

The operation and termination of the MNA remedy must also be described in the CMI workplan to be submitted by RMC for approval by EPA. In the CMI workplan, RMC will propose for EPA approval the criteria for measuring satisfactory progress. Every 2 years after the workplan approval, RMC must submit a report assessing whether MNA is progressing satisfactorily. If after 10 years the comprehensive groundwater monitoring program does not demonstrate that MNA is performing as expected, then RMC must propose an alternate remedy for EPA approval, and then implement the approved alternate remedy to achieve the corrective action objectives for the groundwater remediation.

Other Certification, Monitoring, Reporting, Institutional Control, and Financial Assurance Requirements.

As part of the Corrective Action, RMC will:

- Provide certification by a responsible corporate officer or duly authorized representative of all documents submitted pursuant to this Final Decision, as required in the Consent Decree entered in this matter.
- Implement institutional controls for the land, soil, and groundwater portions of the RMC Facility that are the subject of this Final Decision. The institutional controls shall ensure

that RMC property use remains industrial/commercial; the soil and onsite Containment Cell at the facility are not disturbed in a manner that poses a risk to workers or interferes with the implementation of the final remedy; groundwater monitoring wells are maintained until the MNA criteria approved in the CMI workplan are achieved; and the wells are approved for abandonment by EPA.

- Within 30 days of receipt of this Final Decision, provide detailed estimate of capital costs for implementing the final remedy.

- Obtain financial assurance for completion of the final remedy, including operation and maintenance (O&M), within 90 days of the Final Decision.

- Submit CMI monthly progress reports to EPA during the design and construction phases detailing work performed to date, data collected, problems encountered, project schedule, and percent project completed. Progress reports are due by the 15th day of each month following the Final Decision. Submit CMI progress reports semiannually for O&M activities upon approval of the Construction Completion Report.

The final remedy selected by EPA meets the threshold criteria that reflect the performance standards that must be achieved, including:

- Protect Human Health and the Environment
- Attain Media Cleanup Standards Set by EPA
- Control the Sources of Releases
- Comply with Any Applicable Standards for Management of Wastes

The final remedy also considers balancing criteria that represent a combination of technical measures and management controls that helped identify the best remedy, including:

- Long-term Reliability and Effectiveness
- Short-term Effectiveness
- Reduction in the Toxicity, Mobility, or Volume of Wastes
- Implementability
- Cost

Public Participation and Comments

A forty-five (45) day public comment period was held from June 27, to August 11, 2008. Comments were received from Citizens Gas and the City of Beech Grove, Indiana during the public comment period.

Public Comments and EPA's Response to Comments

Comments received on the proposed remedy from the Citizens Gas/Citizens Energy Group and

City of Beech Grove were considered and addressed in the final remedy. As a result, the proposed remedy was modified by EPA to address concerns regarding whether the location of the Containment Cell for consolidation of remediation wastes ensured proper storm water management and potential future development of the RMC facility.

The following narrative summarizes written comments on the proposed remedy and EPA's response to each comment. Each comment is numbered and presented in italicized type. Citizens Gas, a neighboring property owner, raised a number of issues regarding the Statement of Basis in a September 9, 2008, letter. After reaching an agreement with Refined Metals Corporation, Citizens Gas withdrew all of its comments except the following:

1. Citizens Gas requested that the containment cell be located in the northwest portion of the Refined Metals Property, north of the former operational and parking areas and west of the drainage ditch.

Response: EPA agrees that the proposed location of the containment cell could have had some adverse impacts on Citizens' property. The original location was proposed based upon EPA guidance which suggested that it is appropriate to manage waste in its place rather than transfer it to another location. However, the policy allows, under certain conditions, hazardous wastes may be moved within such areas without triggering RCRA land disposal restrictions. Since the location proposed by Citizens Gas is not an uncontaminated area requiring further analysis and approval, the containment cell will be relocated.

2. Citizens Gas requested that Refined Metals be required to develop a storm water management plan both during and following construction of the corrective measures to prevent contaminated storm water from migrating onto Citizens Gas property.

Response: The relocation of the containment cell, as described above, and proper engineering design, should alleviate runoff from the Refined Metals property. The final design plan will be submitted to EPA for approval and the design will be properly engineered and aesthetically acceptable.

3. Citizens Gas requested that Refined Metals be required to develop an air deposition management plan that will prevent contaminants from becoming airborne during Refined Metals' implementation of its corrective measures.

Response: EPA agrees that airborne particulate matter generated during the excavation process should be addressed. EPA will require that RMC include a plan to prevent airborne particulate matter in its Corrective Measures Implementation (CMI) Plan.

City of Beech Grove Comments

The City of Beech Grove provided comments which focused on the future development potential of the property, specifically that the design, location, and timing of the action and the involvement of the City are critical. The following comments were raised:

1. The City requested that the following be considered in the decision regarding the containment cell:

- *a. Minimizing the volume of the contaminated media contained onsite (and thus the size of the cell) to the extent possible considering that off-site disposal is a viable option;*
- *b. Locating the containment cell in a manner that maximizes the acreage for development purposes, particularly indicating that locating along the boundary of Citizens Gas facility would be good from future reuse options;*
- *c. Sizing the containment cell in a manner that does not detract from the visual aesthetics of the site for potential future redevelopment (balancing vertical and horizontal dimensions); and*
- *d. Establishing a perimeter, access points, and access control for the containment cell to not limit future redevelopment.*

Response: As described above, EPA has agreed to relocate the containment cell to the northwest corner of the RMC property. The Containment Cell will not be any larger than necessary, and the design will be properly engineered and aesthetically acceptable. These issues will be addressed in the CMI workplan to be submitted to EPA for approval.

2. The City requested that EPA expedite the Workplan process so that implementation of the corrective measures can commence.

Response: EPA will work as expeditiously as possible to review and approve the Workplan for implementation of the Final Remedy. The Consent Decree related to this matter requires Refined Metals to submit to EPA for approval a Corrective Measures Implementation Program Plan within 60 days of receiving notification of the selected corrective measures.

3. The City requested that it be designated as a corresponding party in the Workplan development process and implementation of corrective measures activities, and that a standard and a process for ongoing communication with the City be incorporated into the Workplan.

Response: EPA has an entered Consent Decree with Refined Metals that outlines the requirements for communication regarding the development of plans and implementation of measures. EPA will keep the City informed about the process of implementing the Final Decision. EPA can share publicly available documents including workplans, reports, and correspondence. As part of the Corrective Measures, Refined Metals will prepare and implement a Community Relations Plan (CRP). The CRP will designate a public repository for information regarding the site.

Future Actions

On August 31, 1998, the United States District Court for the Southern District of Indiana entered a Consent Decree in the matter of U.S. v. Refined Metals Corporation. The Consent Decree requires RMC to implement this Final Decision. The Consent Decree also requires RMC to provide financial assurance for the corrective action work. The future actions, beginning with submission of the CMI Work Plan, will begin as described earlier in this Final Decision.

Corrective Action Complete Determination

Once RMC believes it has met its corrective measures obligations, it may send a request to EPA Regional office for consideration for a Corrective Action Complete Determination (CACD). This request should include a written explanation justifying how RMC has satisfied the criteria for the CACD, based on the information outlined in the February 23, 2005 EPA guidance on CACD.

Administrative Record

The Administrative Record upon which the final remedy was selected is available at the Beech Grove Public Library, 1102 Main Street, Beech Grove, Indiana and the 7th Floor Records Center at EPA Region 5, 77 W. Jackson Blvd., Chicago, IL.

Declaration

Based on the Administrative Record compiled for this corrective action, EPA has determined that the selected remedy selected for the RMC Facility is appropriate and is protective of human health and the environment.

Margaret Guerriero Director
Land and Chemicals Division
U.S. Environmental Protection Agency
Region 5

Date September 17, 2009

Attachments

use, the comparison of the laboratory and XRF results must achieve a coefficient of determination (r^2) equal to or greater than 0.70.

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

ENGINEERING COMMENTS

The Engineering Section has reviewed the Draft Preliminary Corrective Measures Design for Refined Metals in Beach Grove, Indiana. The current report does not contain significant material for an engineering approval.

Comment 1. Provide the following detailed calculations showing that this cell is designed properly:
- **a. Slope stability calculations**
- **b. Soil erosion calculations (e.g., RUSLE)**

Response: Additional Engineering calculations have been provided in Appendix C of the Corrective Measures Design.

Comment 2. Section 6.3 Containment Cell Construction – Revise the drawings to Show the minimum 3% slope of the top of the cell. If necessary, provide the contours on the top of the cell at 1 foot intervals.

Response: A "minimum grading" configuration has been added to Sheet 5 of the design drawings.

Comment 3. Closure Cost-estimates – Include the following cost:
- **a. Closure Certification**
- **b. Contingency Allowance (20% recommended by EPA Cost Pro)**

Response: The Closure Cost - Estimate has been revised to include a separate line item for the closure certification and the contingency has been increased to 20%.

OLQ Chemistry Services Section – Science Services Branch

1. In Appendix A Section 2.3, Hazardous Waste Management Units, the consultant proposes closure sampling based on XRF, a screening instrument, after correlations with laboratory results of 20% of the samples. This section states that laboratory results will be evaluated against the corresponding average XRF concentration and a correction factor (regression equation) will be developed for each parameter. It should be noted that a minimal acceptable regression

(r^2) would be 0.821. Due to relative large number of samples, this procedure is acceptable if the minimum acceptable r^2 = 0.821. If this correlation is not achieved than another 10% of the samples will need to be analyzed. If the correlation is still not achieved, then all samples will need to be analyzed.

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We believe this addresses the comments raised on the Pre-Final Corrective Measure Design. In addition to incorporating the changes and edits described above we have also made addition edits to refine the design and provide additional detail.

If you have any questions, please call me at 610-840-9122.

Sincerely,

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Matt Love, Exide Technologies (RMC) (1 copy)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

DATE: September 27, 2000

SUBJECT: Transmittal of Monitored Natural Attenuation Framework

FROM: William E. Muno, Director
Superfund Division

TO: Superfund Staff

Attached is the document "Region 5 Framework for Monitored Natural Attenuation Decisions for Ground Water" which I have approved for release in the Region 5 Superfund Program. The Framework provides technical direction in the Region 5 Superfund Program based on the final OSWER Directive on the *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites*. The document is a framework to be used to ensure that the proper data is collected when making monitored natural attenuation remedy decisions. It includes a discussion of the process of making natural attenuation decisions and a brief explanation of the use of the natural attenuation data in the evaluation process.

In order to maximize the sound science represented by the Framework while minimizing decision delays, the Framework is to be implemented in a phased approach with a transition period for full implementation by October 1, 2001.

- For those sites without an approved workplan and where Monitored Natural Attenuation (MNA) is proposed for consideration, the data requirements of the Framework shall be fully implemented now.
- For those sites already considering MNA as a remedial alternative or remedy modification with an approved workplan for data collection, the recommendations of this Framework should be considered. The site's project manager should consult with a Region 5 Superfund geologist to determine what modifications to the existing data collection efforts are required to adequately evaluate MNA consistent with the Framework.
- For those sites where MNA has been selected and/or those sites which are in the process of implementing MNA, the ground-water sampling requirements contained in the Framework should be fulfilled by the MNA monitoring program. In addition, a comprehensive contingency remedy including implementation criteria as discussed in the OSWER Directive should be developed for these sites.

The Framework document includes the Framework text; one figure (a flowchart of the decision-making process); three tables (a table summarizing the various natural attenuation processes, a table listing required indicator parameters and sampling frequencies, and a table summarizing the data uses of each parameter); and a glossary of technical terms.

The Framework was developed by a workgroup composed of the hydrogeological support staff

(Luanne Vanderpool, Doug Yeskis, Gary Cygan) and five RPMs (Brad Bradley, Karen Cibulskis, Ross Del Rosario, Dion Novak and Terese Van Donsel). If you have any questions on the document, please contact the workgroup co-chairs (Luanne Vanderpool at 3-9296 or Doug Yeskis at 6-0408) or any other member of the workgroup.

REGION 5 FRAMEWORK
FOR
MONITORED NATURAL ATTENUATION DECISIONS
FOR GROUND WATER

Introduction - Monitored Natural Attenuation (MNA) is an increasingly utilized remedial option for contaminated ground water. This Framework outlines the types of data that will be used to evaluate MNA. Typically MNA is selected as a remedy in combination with one or more other actions (e.g. source control); or selected as a remedy modification to replace another action. This Framework is not meant to serve as a replacement for proper technical review from a qualified hydrogeologist, but is instead meant to educate Remedial Project Managers (RPMs) on the MNA evaluation process and to provide general direction on the type and amount of information needed for decision-making. The major decisions and actions required to evaluate and implement monitored natural attenuation are summarized in the flowchart in Figure 1. When possible, the specific boxes in Figure 1 are cited in the text of this Framework.

This Framework summarizes the current state-of-the-science and the U.S. EPA policy on the use of monitored natural attenuation in the Superfund program. As additional research, site investigations and remedial actions are completed, this paper should be revised to include new information and concerns. This Framework is applicable to the majority of Superfund sites; however, unusual, site-specific circumstances may require approaches other than those specified in this document. In these instances, the appropriate Regional hydrologists/geologists/technical specialists should be consulted. A reference list for the citations in this Framework, a list of other sources of information, and a glossary for italicized terms is attached.

What is Monitored Natural Attenuation? -Monitored Natural Attenuation is a remedy alternative that relies on natural attenuation processes to achieve site-specific remedial objectives within an acceptable timeframe. Natural attenuation is defined as "naturally occurring processes in the environment that act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater". These processes are briefly described in Table 1.

Current U.S. EPA policy concerning the use of MNA for the remediation of ground water is provided in the OSWER Directive, **Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action and Underground Storage Tank Sites** (U.S. EPA, 1999a). When relying on natural attenuation processes for site remediation, the U.S. EPA prefers those processes that are *destructive* (U.S. EPA, 1999a, page 3). Biodegradation (which may be aerobic or anaerobic) is the most important destructive process, although radioactive decay and abiotic degradation of some compounds does occur. The other attenuation processes are *nondestructive*. While natural attenuation of organic compounds (U.S. EPA, 1998, Appendix B) generally means breakdown (biodegradation) by microorganisms, natural attenuation of metals (Waters et al, 1998) often means immobilization or transformation by the soil matrix, geochemical changes and/or dispersion.

When the U.S. EPA implements natural attenuation as a remedy at a Superfund site, the Agency uses a monitored natural attenuation approach. The selection of a MNA remedy assumes that natural attenuation can be documented to be occurring at a site as discussed in this Framework.

The MNA remedy involves establishing a long-term monitoring program (Figure 1, Box 11b) with criteria for evaluating the monitoring data to determine if contaminant levels are decreasing as expected (Figure 1, Box 11a). The use of MNA also has the expectation that it will be used "in conjunction with other active remediation measures (e.g., source control)" (U.S. EPA, 1999a, page 17) and that a contingency remedy (Figure 1, Box 8a) will be developed, which can be implemented if MNA fails to perform as anticipated or required (U.S. EPA, 1999a, page 24). This Framework does not address the issues of source control (Figure 1, Box 1c) or contingency remedies (Figure 1, Box 8a) that are part of the MNA decision.

What Information is Needed? - A detailed site characterization is required to evaluate the possible implementation of MNA as a remedial alternative. The characterization should include collecting data to define (vertically and horizontally over time) the nature and distribution of the contaminants of concern and contaminant sources, as well as the potential impacts on receptors as listed below (U.S. EPA, 1998, page 34)(Figure 1, Box 1b):

- data on the location, nature, and extent of contaminant sources
- data on the location, nature, extent, and concentrations of dissolved contamination
- chemical properties of the contaminants and the subsurface materials which the contaminants migrate through
- contaminant phase distribution and partitioning (such as presence of *NAPL*, gaseous phases, dissolved phases)
- rates of biological and non-biological transformation
- ground-water geochemical data (major anions and cations, organic carbon, pH, etc.)
- geologic information on the type and distribution of subsurface materials (transmissive vs. non-transmissive materials, thicknesses and horizontal extent)
- aquifer hydraulics and characteristics, including *hydraulic conductivity* and *hydraulic gradients*, particularly preferred flow pathways
- location of areas of recharge and discharge and rates
- potential contaminant migration pathways to points of exposure to human or ecological receptors
- flux of water through areas of recharge and discharge
- toxicity versus carcinogenicity (risk, concentration limits, etc.)
- an understanding of how all of these factors are likely to vary with time

A conceptual site model should be developed to integrate site characterization data and guide both investigative and remedial actions. The conceptual model provides the basis for assessing all potential remedial technologies including MNA at the site. A site-specific conceptual model is a three-dimensional representation of the ground-water flow and *solute* transport system. This model conveys what is known or suspected about contamination sources, release mechanisms, and the transport and fate of those contaminants and includes the site's geochemical and biochemical conditions. The conceptual model should indicate ORP *(oxidation-reduction potential)* conditions at the site and identify any zonation of ORP conditions along contaminant flowpaths since many degradation and transformation processes are controlled by ORP conditions. The conceptual model should also indicate whether conditions exist to support the biological activity necessary for biodegradation and biotransformation processes. "Conceptual site model" is not synonymous with "computer model" or "simulation model"; however, a computer/simulation model may be helpful for understanding and visualizing current site conditions or for predictive simulations of potential future conditions. The conceptual site model should be constantly evaluated during the site characterization process against all possible remedial alternatives. As the model is evaluated, additional site characterization data may be necessary to complete the MNA evaluation.

All potential exposure pathways to contaminants should be identified during site characterization. If currents threats to human health or the environment are identified (Figure 1, Box 4b), remedial measures should be evaluated, selected and implemented prior to further consideration of MNA (Figure 1, Box 1c). MNA should not be considered as a possible remedial method until current, unacceptable exposure pathways have been eliminated. To ensure protectiveness, site risks should be thoroughly evaluated and all pathways of exposure should be considered (including commonly overlooked pathways such as volatilization into basements, migration into sewer systems, etc.) as well as the extent of <u>all</u> chemical contamination. When considering MNA, the evaluation of the extent of contamination may be broader than the original delineation of contaminants of concern in order to include less obvious compounds as described in detail in the OSWER Directive (U.S. EPA, 1999a, page 5) and to quantify degradation by-products (i.e., daughter products) of the contaminants of concern (which may be more toxic and/or mobile than the parent compounds).

MNA should be considered an unlikely remedy to be considered for compounds that have a high degree of persistence and toxicity.

<u>Should I consider MNA for my site?</u> - Once site characterization data has been collected and a conceptual model is developed, the next step is to evaluate the potential effectiveness of MNA as a remedial alternative. It must be recognized that demonstrating MNA may not be easy and that MNA is not always an effective remedial alternative. The National Research Council (2000) cautions:

> Although natural attenuation has been well documented as a method for treating the fuel components benzene, toluene, ethyl benzene, xylene (BTEX); currently it is not well established as a treatment for most other common classes of groundwater contaminants. Under limited circumstances, it can be applied at sites contaminated with other types of compounds, such as chlorinated solvents and metals, but its successful use will depend on attenuation rates, site conditions, and the level of scientific understanding of processes that affect the contaminant. In some cases, natural attenuation will be effective only at sites with special environmental conditions conducive to attenuation of the contaminants in question. In other cases, the use of natural attenuation is problematic because scientific understanding is too limited to predict with sufficient confidence whether this strategy will protect public health and the environment.

Analyzing the data generated by site monitoring is the next step in evaluating MNA. Although the evaluation process is the same for all sites, the level of effort needed to carry it out varies substantially with the complexity of the site and the likelihood that the contaminant is controlled by a natural attenuation process. While natural attenuation may be a feasible alternative in many cases, it must be understood that a higher level of data gathering and analysis is required to demonstrate MNA when the contaminant is likely to be persistent, is likely to be mobile, the controlling attenuation mechanisms are uncertain, and/or the hydrogeology is complex.

The demonstration of MNA should follow a three-tiered approach. In this approach, successively more detailed information is collected as required to establish a net loss of contaminants and the processes responsible for this loss. All data (including hydraulic conductivity data and water- level measurements) used for this evaluation should be collected, handled and analyzed consistent with the U.S. EPA requirements for quality assurance/quality control. These three categories of supporting site-specific information are commonly referred to (U.S. EPA, 1999a, page 15) as "lines of evidence" (Figure 1, Boxes 5b and 6c).

1. **Primary Category of Information**
   Historical ground-water and/or soil-chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration. Data should include analytical results for the contaminants of concern and their degradation by-products from nine or more rounds of samples collected under non-pumping conditions over a period of three to five years. There should be at least two years of quarterly sampling to evaluate seasonal effects on the contaminant concentrations. This data should be collected from appropriately located sampling points, including within the plume source area, within the center of the plume and at the leading edges of the plume. In addition, samples should be collected from points located vertically (above and below) and horizontally (upgradient and downgradient) outside the area of ground-water contamination. The most recent analytical data on ground water should be no more than two years old at the time of the evaluation. Demonstrating that a trend of decreasing contaminant concentration is clear and meaningful should be based on statistical tests which indicate a high degree of confidence in the apparent trend line. Additional rounds of samples may be required to demonstrate this trend.

2. **Secondary Category of Information**
   Hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes and the rate at which such processes will reduce contaminant concentrations. This data should be collected from appropriate locations that are distributed both vertically and horizontally throughout the plume. Sample locations should consider heterogeneties in geologic structures and in the spatial distribution of contaminants. Ground-water flow paths and rates should be fully and accurately defined, as this is one of the most important factors in evaluating the applicability of natural attenuation. The locations should be sampled under non-pumping conditions and should include, at a minimum:

   a. Contaminants of concern and their potential degradation by-products as determined from literature searches (Fetter, 1993, Chapelle, 1993, U.S. EPA, 1998).
   b. Routine Indicator Parameters, including pH, dissolved oxygen, ORP (a.k.a.: Redox, Eh or *Oxidation/Reduction Potential*), temperature, and specific electrical conductance (a.k.a.: SEC) (see Table 2 and Table 3 for details).
   c. Indicator Parameters which can be used to support MNA decisions, such as: alkalinity, chloride, nitrite, nitrate, dissolved methane, iron (II) and iron (III), chloride, sulfate, sulfide, total organic carbon, etc. (see Table 2 and Table 3 for details).
   d. Vertical and horizontal characterization of the distribution of *hydraulic conductivity*

and its effect on contaminant concentrations. Most of the field methods used to determine hydraulic conductivity represent horizontal hydraulic conductivity. For sites where vertical components of ground-water flow and/or contaminant transport are present, the vertical hydraulic-conductivity component should also be determined. Hydraulic conductivity estimates should be based on:

- Single and multiple-well aquifer tests (at least 25% of wells single-well tested and one or more multiple-well aquifer tests).
- Single-well aquifer tests (at least 50% of wells tested, or all wells if fewer than 10 wells present). Note: These may under-estimate hydraulic conductivity if large-scale heterogeneties are present.
- Other field characterization methods (e.g., flowmeters, tracer tests) may be appropriate under certain site conditions, which can be evaluated by the appropriate Regional hydrologists/geologists/technical specialists. Tracer tests can be especially helpful in determining contaminant transport properties, especially since these are performed at the field scale.

Note: Laboratory permeability tests should be performed on low permeability soils (clays, silty clays, marls, etc.) only.

e. Water levels should be measured to determine ground-water-flow directions. These water levels should be taken from possible receptors, including surface-water bodies and pumping wells.

f. Seasonal variations and trends should be evaluated by obtaining data from different times of the year to determine if changes in contaminant concentrations, indicator parameters or *water types* are caused by natural attenuation or may be attributed to seasonal variability. To determine seasonal variations, the effects of different, potential influences on water quality (such as recharge events, pumping effects, etc.) need to be evaluated and documented. In most cases, this will require quarterly water-quality samples, with more frequent water-level measuring events during the period of evaluation of the applicability of natural attenuation. These water-level measuring events usually are monthly, but continuous monitoring (e.g. use of data loggers) of water levels is needed to assess high frequency events, such as pumping or tidal cycles.

The information (a. thru f.) listed above should be incorporated in a detailed site-specific conceptual model that describes the contaminant migration pathways and the natural-attenuation processes involved, as well as estimates of travel times of contaminants from sources to receptors. The conceptual model should also include degradation by-products, degradation rates and potential future receptors. Consideration should be given to all applicable processes that may affect the contaminant concentrations as listed in Table 2, when determining the list of field and indicator parameters to be analyzed at a site.

3. **Supplemental Category of Information**

Data from field or *microcosm* studies which directly demonstrate the occurrence of a particular natural attenuation process at the site. In microcosm studies ground-water and aquifer materials are collected and studied in the laboratory in small containers (microcosms) The disappearance of the contaminant, along with the disappearance of terminal electron acceptors or the appearance of appropriate reduction products, is measured over time to demonstrate the ability of native microorganisms to degrade given compounds. Like any bench-scale testing done as part of treatability studies, care should be taken to ensure the transferability of the results from the laboratory to field conditions. Microcosm studies can also be used to estimate biodegradation rates; however, field-derived values are preferred due to uncertainty about the representiveness of the microcosm results for actual field conditions. Microcosm studies are time-consuming and expensive; they should only be undertaken at sites where there is considerable uncertainty concerning the biodegradation potential of the contaminants.

How is the MNA Decision Made? - The primary category of information uses historical contaminant data to determine if the contaminant plume is shrinking, stable, or expanding (Figure 1, Box 6b). This first category of information can be used to show that a contaminant plume is being attenuated; it does not necessarily show that contaminant mass is being destroyed nor does it provide the information necessary to evaluate the applicable attenuation process(es). For sites which have sufficient historical monitoring data, the primary category of information may be adequate to demonstrate remediation by MNA. In the absence of historical evidence for reductions in contaminant concentrations (i.e. the plume is expanding), the argument for natural attenuation probably cannot be made. If the primary category of information is inconclusive or inadequate, it is necessary to obtain the secondary category of information (Figure 1, Box 6c). Even when the secondary category of information is available, field monitoring and contaminant data collection should continue in order to ultimately substantiate the primary category of information. For sites with insufficient historical monitoring data, the collection and evaluation of geochemical data (secondary category of information) should be used to expedite the demonstration of remediation by MNA rather than waiting to develop a longer historical record. When data from the secondary category of information are inadequate or inconclusive, data from the supplemental category of information may be used to help support information from the primary and secondary categories. The supplemental category of information, by itself, is not sufficient to support a MNA decision.

Although not a category of information, solute fate and transport simulation models may be valuable when evaluating natural attenuation when properly chosen and implemented. Such models can be used to evaluate the relative importance of natural attenuation mechanisms, to predict the migration and attenuation of the dissolved contaminant plume through time, to predict cleanup timeframes, or to provide an estimate of time required to reach a receptor well. The use of solute fate and transport modeling in the natural attenuation evaluation is described by Wiedemeier, et al., 1999.

Even when the primary category of information is conclusive, further effort should still be made to develop the secondary category of information. The challenge in evaluating MNA is not only demonstrating that natural attenuation is occurring. This can be a relatively easy task. Rather, the appropriate evaluation of MNA as a remedial alternative requires making the determination that the natural attenuation processes are taking place at a rate that is protective of human health and the environment (Figure 1, Box 7b), that there is a reasonable expectation that these processes will continue at acceptable rates for an acceptable period of time (Figure 1, Box 8b), and that the MNA remedy is capable of achieving the site specific remediation objectives within

PRE-FINAL CORRECTIVE MEASURE DESIGN

Prepared For:

REFINED METALS CORPORATION
Beech Grove, Indiana

Prepared By:

ADVANCED GEOSERVICES
West Chester, Pennsylvania

Project No. 2003-1046-18
April 12, 2010

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TO BE SIGNED AND SEALED AT TIME OF FINAL DESIGN SUBMISSION

Paul G. Stratman, P.E., P.G.
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1.0 INTRODUCTION

1.1 GENERAL

Presented herein is the design report describing the proposed Corrective Measures to be completed by Refined Metals Corporation (RMC) to address elevated concentrations of lead and associated inorganic compounds in soil, sediment and groundwater identified on and around the RMC facility in Beech Grove, Indiana. The design report, in conjunction with the design drawings, specifications, Construction Quality Assurance Plan, and other attachments, comprises the Corrective Measures Design (CMD). The CMD is being submitted pursuant to the requirements of a Consent Decree negotiated between RMC, the United States Environmental Protection Agency (USEPA) and Indiana Department of Environmental Management (IDEM) Civil Action No. IP902077C.

This submission of the CMD is intended to represent a Pre-Final level of completion. As stated in the Preliminary CMD submission the format and level of detail of the CMD process represent a hybrid between the highly structured requirements identified in the Consent Decree, and the single submission format requested in the Final Decision Document. As agreed upon between representatives of RMC, USEPA and IDEM, the Preliminary submission presented the major design components at approximately a 20 to 30% level of completion to obtain regulatory consensus.

This Pre-Final submission has been developed to advance the amount of detail to a level of approximately 90%. The major design components presented in the Preliminary submission (including containment cell location and configuration; general excavation limits and confirmatory sampling techniques; pre and post-remediation storm water management strategies; and anticipated permitting requirements) have not changed. This submission includes attachments presenting construction specifications, Construction Quality Assurance Plan, Inspection and Maintenance Plan (including groundwater monitoring plan), engineering calculations, cost estimates and construction schedule. The design drawings have been advanced to include additional details and schematics, sequence of construction information, and construction notes.

1.2 BACKGROUND

The Refined Metals Corporation (RMC) Beech Grove facility (Site) was the location of a secondary lead smelting and refining operation from 1968 through 1995. The general location of the site is shown on Figure 1 and a detailed plan of the Site is shown on Sheet 1 of the design drawings. During its operational life, the facility handled hazardous materials or hazardous wastes under the Resource Conservation and Recovery Act (RCRA). These primarily consisted of lead acid automotive and industrial batteries, and lead-bearing materials that were processed for lead recovery.

In accordance with the requirements of RCRA, the facility completed and submitted a RCRA Part A permit application. On November 19, 1980 the facility was granted approval to operate two hazardous waste management units under Interim Status: 1) indoor waste piles; and 2) outdoor waste piles. Facility documents also identify a surface impoundment (lagoon) as a RCRA permitted unit; however, it does not appear to have been included on the Facility Part A permit until after 1991. The Surface Impoundment was, and still is, used to collect and manage facility storm water runoff. See Sheet 1 of the design drawings for the location of the RCRA Hazardous Waste Management Units (HWMUs).

The former indoor and outdoor waste piles were removed when normal facility operations ceased. The site sat idle after December 31, 1995 except for the wastewater treatment system which remained in operation to collect and manage storm water runoff from the lagoon and other site areas. Between August 2009 through early-January 2010 all buildings and structures were decontaminated and demolished, with the exception of four pump houses and the lagoon which were decontaminated, but remain in operation for on-site storm water management. Decontamination and demolition activities were performed in accordance with the *Draft Decontamination and Demolition Plan* (Advanced GeoServices March 4, 2009) and the *Decontamination and Demolition Implementation Plan* (Focus Contracting, June 8, 2009) both of which were submitted, reviewed and approved by the USEPA and IDEM. A summary report of the decontamination and demolition activities is being prepared on a parallel track with preparation of this CM Design submission and will be included as an attachment to the Corrective Measures Completion Report to be provided following completion of the Corrective Measures.

Throughout the decontamination and demolition process storm water from the impervious former manufacturing area continued to be collected, treated as appropriate, and discharged to the City of Indianapolis POTW. The impervious former manufacturing areas (former pavement surfaces and remnant floor slabs) were cleaned as part of the decontamination and demolition activities. Storm water sampling performed after completion of site cleaning activities has demonstrated that storm water from the lagoon and cleaned surface areas of the site can be discharged without requiring pre-treatment. In an effort to reduce the hydraulic loading on the POTW, the City of Indianapolis has requested that RMC cease discharge of the clean storm water to the sanitary sewer following completion of decontamination and demolition activities. At this time RMC has submitted a request for a "No Exposure Certification for Exclusion from NPDES Storm Water Permitting" to allow surface discharge of the storm water currently sent to the POTW. If storm water currently sent to the POTW will be surface discharged, it will most likely be sent to the drainage ditch at the north end of the property using the existing system of pumps and internal conveyance piping. RMC also requested and was granted an extension from the City of Indianapolis to continue storm water discharge to the POTW until appropriate approvals for surface water discharge can be secured. The extension expires July 10, 2010.

1.3 PURPOSE

On August 31, 1998 Refined Metals Corporation entered into a Consent Decree with the United States Environmental Protection Agency (USEPA) and the Indiana Department of Environmental Management (IDEM), Civil Action No. IP902077C. The technical objectives of the Consent Decree are as follows:

1. Effectuate closure of waste piles and surface impoundment by submitting a closure plan and post-closure plan, if necessary, and then to implement the plan(s) as approved;

2. Perform a RCRA Facility Investigation (RFI) to evaluate and determine the full nature and extent of releases and collect information necessary to support a Corrective Measures Study, or Interim Measures;

3. Perform Interim/Stabilization Measures to abate threats to human health and the environment;

4. Perform a Corrective Measures Study to develop and evaluate alternatives and to recommend a final corrective measure(s); and,

5. Perform Corrective Measures.

1.3.1 Waste Pile and Surface Impoundment Closure Investigations

Pursuant to Section VI, Paragraph 37 of the Consent Decree (Compliance Requirements for Closure), Advanced GeoServices Corp. (AGC) prepared a Closure Plan on behalf of RMC for the HWMUs. The Closure Plan was prepared in accordance with Indiana Department of

Environmental Management (IDEM) Hazardous Waste Management Unit Closure Guidance (Waste-0013-ND) and Risk Assessment Addendum.

The Closure Plan (Version 3.0 dated July 17, 1999) was implemented between the fall of 1999 and spring of 2000. The results of the investigation conducted pursuant to the approved Closure Plan were presented in the Closure Investigation Report (AGC, June 2000). Comments on the Closure Investigation Report prompted additional soil sampling within the HWMUs in December 2001, January 2007 and August 2007. Results of the Closure Investigation activities were compiled in a Comprehensive Closure Investigation Report (AGC March 27, 2007), with an addendum containing supplemental sampling information on January 29, 2008 and a response to IDEM comments on April 8, 2008.

1.3.2 RCRA Facility Investigation

Pursuant to Section VI, Paragraph 42 of the Consent Decree (Compliance Requirements for Corrective Action), RMC prepared and implemented a RCRA Facility Investigation (RFI) Work Plan (AGC March 3, 1998) which was conditionally approved by the USEPA in writing on June 3, 1999. The RFI Work Plan was revised by AGC on July 7, 1999 in response to the USEPA conditional approval. Final USEPA approval of the RFI Work Plan was received in a letter dated August 17, 1999. The USEPA approved RFI Work Plan was implemented by AGC on behalf of RMC in late 1999 and early 2000. A Phase I RFI Report was submitted by RMC on August 31, 2000. Based on the results of the Phase I RFI and as required by the USEPA a Phase II RFI Work Plan was prepared and submitted (AGC December 20, 2000). Following minor revisions (based on USEPA comments) in an addendum dated June 27, 2001, the Phase II RFI Work Plan was approved by the USEPA on July 13, 2001. The Phase II RFI Report was prepared and submitted by AGC on May 3, 2002 and subsequently revised in November 18, 2002.

1.3.3 Interim Corrective Measures

Results of the Phase I RFI identified elevated concentrations of lead in the shallow surface soil/sediment along the former railroad spur entering the facility from the railroad tracks north of the site. To reduce the potential for that soil/sediment to be eroded and transported to areas off-site RMC prepared a Interim Measures Work Plan (AGC December 20, 2000), consisting of a series of check dams across the drainage ditch that was approved by the USEPA on July 13, 2001. AGC implemented the Interim Measures Work Plan in September 2001. Those measures remain in-place to date and based on visual observations provide detention and filtration to storm water flow in the ditch. The check dams will remain in-place until remediation is performed in the drainage ditches on either side of the railroad spur. No other interim measures were performed or required at the facility.

1.3.4 Corrective Measures Study

The Corrective Measures Study (CMS) was performed in two phases pursuant to a CMS Work Plan (AGC April 21, 2003), as revised by AGC on July 11, 2003 and October 16, 2003 and conditionally approved by USEPA on November 5, 2003. The Phase I CMS consisted of supplemental soil sampling (including shallow surface soil ("sediment") in the mowed grass swale along South Arlington Avenue and drainage ditch along the CSX railroad tracks) and groundwater sampling (completed by AGC during the fall of 2003), and completion of a Baseline Human Health Risk Assessment (BHHRA) (performed by Gradient Corporation (Gradient)). The BHHRA separated the site into two exposure areas identified as "Grassy Areas" and "On-Site Areas". Figure 2 shows the specific areas represented by Grassy Areas and On-Site Areas. The results of the Phase I CMS were initially submitted in a report prepared by AGC on June 22, 2004. The USEPA issued written comments on August 17, 2004 and January 18, 2005 and the Phase I CMS Report was revised on May 6, 2005 and approved in writing by the USEPA on August 23, 2005.

The Phase II CMS consisted of the development and evaluation of cleanup options for those areas of the site impacted above action levels established in the BHHRA and accepted in writing by the USEPA in their approval letter dated August 23, 2005. The Phase II CMS also anticipated remediation of surface soils and sediment with total lead concentrations >400 mg/kg in the right-of-way for South Arlington Avenue, Citizens Gas property along the south side of the Citizens Gas security fence parallel Big Four Road, and drainage ditch within the CSX right-of-way. The Phase II CMS Report was originally submitted by AGC on October 21, 2005. The Phase II CMS Report was revised by RMC through a series of iterations promulgated by USEPA comment letters issued on April 19, 2006, July 13, 2006, November 30, 2006, March 1, 2007 and May 29, 2007. Conditional approval of the August 6, 2007 revision of the Phase II CMS Report was issued by the USEPA in a letter dated January 22, 2008.

1.3.5 Corrective Measures Design

This Corrective Measures Design (CMD) is being submitted to convey the design and construction elements of the Corrective Measures alternatives selected by the USEPA from the Phase II CMS Report and published in the Statement of Basis (USEPA June 2008). As agreed to by USEPA, IDEM and RMC, the CMD approach deviates from both the highly structured approach specified in the Consent Decree, and the single submission format specified in the Final Decision Document. It is believed that the agreed upon approach will both allow for regulatory input during the design process, while expediting the design schedule. The Preliminary Design representing approximately a 20 to 30% level of completion was submitted to USEPA and IDEM on January 8, 2010. Comments on the Preliminary CMD were received in written format in a letter dated February 25, 2010. The USEPA determined that based on the limited scope of comments on the Preliminary CMD that an "on-board" review meeting was not necessary prior to Pre-Final CMD preparation.

It should also be noted that pursuant to discussions between USEPA, IDEM and RMC it was agreed to include Closure of the Interim Status Hazardous Waste Management Units (Indoor Waste Piles, Outdoor Waste Piles and Surface Impoundment) as a component of the CMD. Inclusions of the Closure activities within the CMD allows the design efforts for both proposed remediation activities to proceed in parallel and provides USEPA relevant information regarding the Closure activities, and IDEM relevant information regarding the Corrective Measures. Additional information regarding the interrelationship between the USEPA and IDEM and the Corrective Measures and Closure is provided in Section 3.0.

1.4 ORGANIZATION

This Preliminary design report is organized as follows:

- Section 1.0 - Introduction (provided above);
- Section 2.0 - Facility Background, including operating history and regulatory status;
- Section 3.0 – Regulatory Purview;
- Section 4.0 – Nature and Extent of Contamination;
- Section 5.0 – Statement of Basis;
- Section 6.0 – Design Elements;
- Section 7.0 – Permitting Requirements;

- Section 8.0 – Public Relations;

- Section 9.0 – Schedule and Cost Estimate;

- Section 10.0 - Post Corrective Measures Storm Water Management; and,

- Section 11.0 – Post Closure Inspection and Maintenance.

2.0 FACILITY BACKGROUND

2.1 FACILITY LOCATION

The RMC facility is located at 3700 South Arlington Avenue in Beech Grove, Marion County, Indiana, and approximately four miles south-southeast of downtown Indianapolis. The Site occupies approximately 24 acres, of which approximately 10 acres represented the active manufacturing area (including paved areas and buildings). The remaining 14 acres include grass and wooded areas. The configuration of the Site is triangular, bounded by South Arlington Avenue (oriented in a north to south direction representing the hypotenuse), Big Four Road (along the base), and the common property line with a natural gas company (Citizens Gas) forming the third side. The northwest end of the triangle is truncated by a railroad right-of-way as depicted on Sheet 1 of the design drawings.

The Site is relatively flat with less than 10 feet of total relief. Natural site drainage is toward the north and east. The former manufacturing area included nearly 80,000 square feet (sf) structures including the battery breaker, a wastewater treatment plant, a filter press, material storage building, a furnace room, metals refining area warehouse, a vehicle maintenance structure and offices. As indicated in Section 1.2, all of the structures were decontaminated and demolished to grade between August 2009 and January 2010, except the pump houses which were decontaminated but remain to manage storm water. Decontamination and demolition activities were performed in accordance with the *Draft Decontamination and Demolition Plan* (Advanced GeoServices March 4, 2009) and the *Decontamination and Demolition Implementation Plan* (Focus Contracting, June 8, 2009) both of which were submitted, reviewed and approved by the USEPA and IDEM. Summary information regarding the decontamination and demolition activities will be included as an attachment to the Corrective Measures Completion Report to be provided following completion of the Corrective Measures.

The floor slabs, foundations and site paving remain in-place. Debris resulting from the demolition activities was sent off-site for recycling or disposal, except for non-hazardous masonry rubble that was placed under a geomembrane cover within the footprints of the former battery breaker and material storage buildings to create positive drainage and prevent the ponding of surface water. The paved surface areas drain toward catch basins situated around the Site. The catch basins in-turn, flow to the storm water pump houses. The storm water pump houses convey water directly to the sanitary sewer or into the lagoon. Water transferred to the lagoon is also eventually discharged to the sanitary sewer following under the restrictions for flow and precipitation imposed as part of the temporary discharge permit.

2.2 OWNERSHIP HISTORY

The Site was reportedly undeveloped woodlands until 1968. In 1968, the property was developed as a secondary lead smelter by National Lead. National Lead operated the facility from 1968 through 1980, when it was sold to Exide Corporation. In 1985, the Site was purchased from Exide Corporation by RMC. RMC continued to operate the facility until the cessation of operations on December 31, 1995. From April 14, 1995 through December 31, 1995, operations were reduced to enriching and casting lead ingots from off-specification lead products. Since 1996, no production has taken place at the facility except for operation of the wastewater treatment facility which was used to manage storm water runoff from the former manufacturing areas prior to 2009 demolition activities.

2.3 REGULATORY HISTORY

As stated above, following the promulgation of RCRA, the facility submitted a Part A RCRA permit application. On November 19, 1980 the facility was granted Interim Status as a hazardous waste treatment, storage and disposal facility. The RCRA Subtitle C units included indoor and outdoor waste piles (used to store batteries and lead-bearing wastes), and the

750,000-gallon concrete lined lagoon. A Part B application was submitted during the mid-1980s, although full RCRA permitted status was never granted. The EPA maintains that interim status was lost on November 8, 1985 as a result of RMC's alleged failure to comply with Section 3005(e)(2) of RCRA, 42 U.S.C. 6925(e)(2); RMC did not agree with this allegation.

RMC submitted a revised Part A application on October 26, 1988 requesting an increase in the storage volume for spent batteries. The request was granted on September 20, 1989. A subsequent revised Part A application was submitted to IDEM on December 7, 1990 for an additional increase in the storage volume of spent batteries, but IDEM denied the increase. RMC filed for a stay and was granted interim status. IDEM approved the revised Part A application on June 3, 1991 with the provision that it did not grant interim status under RCRA. The Part B application was not resubmitted. In 1994, the facility withdrew its Part A and Part B permit applications.

A site inspection was performed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980. In 1985, a preliminary assessment was performed under CERCLA. No further action was planned under CERCLA at that time.

3.0 REGULATORY PURVIEW

3.1 SEPARATION OF RESPONSIBILITIES

As stated above, the Consent Decree includes the United States Environmental Protection Agency (USEPA) and the Indiana Department of Environmental Management (IDEM) as regulatory participants. Section VI Paragraph 37 of the Consent Decree (Compliance Requirements for Closure) places responsibility for oversight of closure of the interim status hazardous waste management units (indoor waste piles, outdoor waste piles and surface impoundment (lagoon)) under IDEM and oversight of work in all other areas under the USEPA. This has resulted in parallel investigation activities and slightly different remediation requirements, with the IDEM responsible for those portions of the RMC property contained within the footprint of the HWMUs and USEPA responsible for the remainder on the on-site areas and all off-site areas.

3.2 HWMU CLOSURE

Irrespective of the slightly different remediation standards, this Corrective Measures Design has been developed to include remediation required to affect Closure of the HWMUs. Closure activities specific to the HWMUs are presented separately in Section 6.4 of this Design Report and limits of soil remediation are depicted on Sheet 6 of the design drawings. HWMUs are being remediated to attain Closure to the default Industrial Closure Levels for soil, and groundwater at the lagoon, as established under the IDEM RISC Technical Guidance (Last Revised May 1, 2009) except for arsenic and lead in soil where alternate values will be utilized.

Results of soil sampling conducted within the footprints of the HWMUs are provided on Sheet 3 of the design drawings. Groundwater monitoring for the lagoon has been performed pursuant to the requirements of a Groundwater Monitoring Plan approved by IDEM (AGC, June 8, 2007). A discussion of the results of this groundwater sampling and groundwater sampling conducted in conjunction with the RFI is provided in Section 4.5 of the CMD.

3.3 CORRECTIVE MEASURES

The Corrective Measures activities related to soils and sediment to be completed under the purview of the USEPA are being performed specifically for lead. Within the off-site areas readily accessible by the general public, the remediation level for soil and sediment is 400 mg/kg total lead. On-site, soil remediation will be performed to achieve an area wide Preliminary Remediation Goal of 920 mg/kg. For site wide groundwater, the standards will be 0.010 mg/L for arsenic and 0.042 mg/L for lead, the same values to be applied to groundwater for Closure of the lagoon. The site wide groundwater values were previously identified in the Phase II CMS Report as approved by USEPA.

The Final Decision issued by the USEPA determined that a commercial/industrial cleanup standard applies to the Citizens Gas property and agreed with RMC's interpretation that except for a drainage ditch along the north side of the Citizens Gas property and soil remediation outside the security fence parallel to Big Four Road, no remediation is required on that property and placement of a deed restriction is the only action required as part of the Corrective Measures.

Results of soil sampling conducted off-site are provided on Sheet 3 of the design drawings. A discussion of the results of the groundwater sampling conducted in conjunction with the RFI is provided in Section 4.5 of the Corrective Measures Design and is provided in Tables 1A through 1N. Sampling and evaluation of data being performed in relation to the Monitored Natural Attenuation of lead and arsenic in groundwater are considered components of the RCRA Corrective Measures.

4.0 NATURE AND EXTENT OF CONTAMINATION

4.1 CONSTITUENTS OF CONCERN IN SOIL AND SEDIMENT

4.1.1 RCRA Facility Investigation

Environmental sampling, performed as part of the Phase I RCRA Facility Investigation (RFI) (sample locations RSB-01 through RSB-85) included sampling for arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver. While the results of the Phase I RFI sampling detected the presence of barium, cadmium, chromium, mercury, selenium and silver, with only some exceptions; concentrations were consistently below the Region 9 Preliminary Remediation Goals (PRGs) used for screening results of the Phase 1 RFI sampling. Therefore, only lead and arsenic were retained as the constituents of concern in soil and sediment associated with former facility operations that require remediation as part of the proposed corrective measures. A detailed summary of the investigation activities and results are provided in the Phase I and Phase II (Revision 1.0) RCRA Facility Investigation Reports (Advanced GeoServices March 29, 2000 and November 18, 2002, respectively) and relevant addenda and response to comments.

4.1.2 Closure Investigation

In addition to lead and arsenic, soil sampling performed as part of the Closure Investigation for the interim status Hazardous Waste Management Units (HWMU) indicated that antimony, cadmium and selenium are present in soil immediately beneath the HWMUs in some sample locations at levels exceeding the IDEM RISC Technical Guidance default values for soil. Therefore, antimony, cadmium and selenium are considered constituents of concern, in addition to lead and arsenic within the HWMUs. Results of the Closure Investigation are presented in the Comprehensive Closure Investigation Report (Revision 1.0) (Advanced GeoServices March 27, 2007) and supplemental data submitted in January, 2008.

4.2 BEHAVIOR OF LEAD AND RELATED CONSTITUENTS

A number of the materials formerly used at the facility have toxic characteristics; however, the principal material of concern is lead. Lead is a common metal, and can be found at an average concentration in excess of 30 ppm in natural soils and 1-10 ug/l in surface water. Most lead salts are fairly insoluble in water; however, the solubility depends on the pH, with solubility increasing in more acidic conditions. Movement of lead in soils depends on its adsorption, chelation with organic matter, and the precipitation of the less soluble salts. In general, lead reacts with soil anions or clays to form insoluble complexes, inhibiting its mobility. Lead can be ingested or absorbed by inhalation. Poisoning from acute exposure to lead is uncommon. The primary toxic effects from chronic exposure are on the blood and the nervous system. Antimony, arsenic, cadmium and selenium are all considered insoluble inorganic constituents and their behavior is generally similar to the behavior lead. The only notable difference is that arsenic is naturally occurring in regional soils at levels that have been noted to exceed the IDEM RISC Technical Guidance default values and arsenic is relatively more soluble than lead.

4.3 DISCUSSION OF SOURCE AREAS

Based on the documented operating history of the facility, results of the Closure and RFI sampling activities, and an understanding of the character of the mobility and transport of lead and arsenic, the most significant potential sources of contamination at the facility during its operating history were erosion and transport of lead-bearing solids; fugitive dust; and filling performed using impacted soils or slag resulting from the furnace operations. Sampling activities were designed to target the areas of impact from each of the potential sources. Soil and sediment sample locations are depicted on Sheet 2 and the results of the sampling are provided on Sheet 3. A supplemental qualitative discussion is provided below.

4.4 EXTENT OF IMPACT

4.4.1 Drainage Ditches

Erosion and transport of lead bearing solids from sources, such as the outdoor waste piles or materials tracked from operating areas of the facility may have occurred before the facility was upgraded to capture and treat storm water falling in the active manufacturing areas of the facility. The impacts associated with the erosion and transport of lead impacted solids would be manifested in the form of elevated concentrations in sediment within drainage paths leading from the facility. Sampling was conducted in the drainage ditches along the railroad spur and tracks north of the former manufacturing ("northern drainage ditch"), along the north side of the main driveway and along South Arlington Avenue. The sampling focused on the centerline of the drainage ditches and identified sediment impacted by lead in excess of the 400 mg/kg. In the northern drainage ditch, lead exceeded the 400 mg/kg level to a distance of approximately 600 feet west of the northwest corner of the RMC property; in the driveway drainage ditch, lead exceeded 400 mg/kg along the entire length; and along South Arlington Avenue, lead exceeded 400 mg/kg from approximately 1,000 feet north to 1,000 feet south of the main driveway.

4.4.2 Surface Soil

Fugitive dust emissions are generated by traffic, wind and similar sources that cause dust on the ground surface, exposed waste materials and/or from production areas to become suspended in air and transported. Generally the particulate size of fugitive dust is large and as a result, the area impacted by the fugitive dust is relatively limited. Sampling determined that fugitive dust has caused some impacts to the surface soils on the adjacent Citizens Gas property, the property immediately adjacent to the facility manufacturing area. A BHHRA was conducted for an exposure scenario intended to replicate workers at the Citizens Gas facility, the results of which were included in the Phase I CMS Report. The BHHRA evaluated the potential for the receptor to have adverse impacts from arsenic (using the 95% UCL) and lead (using the mean lead). The results of the risk assessment for arsenic determined that the total excess lifetime cancer risk on the Citizens Gas property is 8x10-6, with a Total Hazard Index of 0.05, which did not represent an unacceptable risk. The lead risk assessment predicted a 95th percentile fetal blood lead level (BLL) of 7.4 ug/dL, which is below the allowable maximum of 10 ug/dL. Through the BHHRA is was determined that lead and arsenic did not represent an unacceptable risk for the exposure scenarios evaluated on the Citizens Gas property and, therefore; remediation was not required as part of the Corrective Measures. As required by the Final Decision, Citizens Gas has agreed to record a deed restriction regarding limitation for future use of their property. Detailed information regarding the deed restriction is being provided separate from this design submission.

Impacts from fugitive dust were not identified in off-site areas north, south and east of the facility, where the property boundaries are typically 200 feet or greater from the former manufacturing area.

4.4.3 Subsurface Soil

During the early operating history of the facility, feed materials destined for recycling and waste products resulting from the recycling process (i.e. slag) were managed on the unpaved exterior surfaces. As a result, shallow subsurface soils have become intermixed with materials containing high concentrations of lead. In addition, various modifications and expansions of the manufacturing area were conducted periodically that required minor amounts of grading. The results of these activities are elevated concentrations of COCs in the shallow subsurface soils. In most areas the depth of impact is less than 12-inches, with a few areas extending up to 36-inches. The only areas deeper than 36-inches are within the HWMU along the northern limits of the manufacturing area where areas of filling and disturbance are as much as 8-feet below existing ground surface. It was also determined that depths within an area of the material storage building HWMU had areas with impacted soil requiring remediation as deep as 6-feet.

4.4.4 Storm Water Lagoon

The storm water lagoon is an interim status HWMU. Sampling was conducted to characterize the nature of sediments within the lagoon and the impact of the lagoon on underlying soils. The results of the sediment sampling (CSED-1 through 4) in the lagoon identified concentrations of antimony, arsenic, cadmium and lead above the IDEM RISC industrial soil default values. The sediment is typically 6-12 inches in thickness and overgrown by cattails. The lagoon is lined by a geomembrane in poor condition and concrete. Sampling conducted during the initial investigation activities included the collection of soil samples from beneath the liner system (CSB-43 through 47). The results of that sampling identified one sample with an arsenic concentration slightly above the proposed cleanup level. It should also be noted that storm water samples collect during and after decontamination and demolition activities did not exceed the discharge limits established by the temporary discharge permit.

4.5 GROUNDWATER IMPACTS

Groundwater conditions have been evaluated through the installation and sampling of twelve (12) shallow and two (2) deep monitoring wells. Monitoring well locations are shown on Figure 3. Groundwater in the shallow zone of saturation near the former manufacturing area occurs as perched zones within thin, laterally discontinuous layers of sand and sandy silts contained in clayey-silt and silty-clay glacial deposits. The monitoring wells identified as "deep" are screened within a middle perched zone located 75 to 85 feet below ground surface. "Depth to water" measurements indicate that the potentiometric surface of the middle perched zone is on the order of 14 to 17 feet below ground surface, while the upper perched zone is typically less than 5 feet below the ground surface.

The results of groundwater sampling conducted as part of the RFI, Closure Investigation and CMS are provided in Tabular format on Tables 1A through 1N. A groundwater contour map is provided for the (January 2007) site wide sampling event on Figure 3. Total results for lead and arsenic from the January 2007 groundwater sampling event for the shallow groundwater wells are also presented on Figure 3.

A review of shallow groundwater sample results, obtained as part of the RFI and Closure activities (Tables 2A through 2N), shows that the current IDEM Industrial Default RISC Criteria for arsenic (10 ug/L) has been exceeded on more than one occasion at groundwater monitoring wells MW-1, MW-2, MW-3, MW-7, MW-8 and MW-10. The 42 ug/L IDEM Industrial Default RISC Criteria for lead is exceeded in unfiltered samples on more than one occasion in MW-2 and MW-7. With the exception of MW-3, each of the wells that exceeds the IDEM Industrial Default RISC Criteria for arsenic or lead is located within or immediately adjacent to an area of the Site identified to contain the most deeply impacted soils.

MW-3 has had two total arsenic results at 11 ug/L, one total arsenic result at 28 ug/L and a result of 170 ug/L. The available filtered results for MW-3 have all been below 10 ug/L and field logs from the sampling event corresponding to the 170 ug/L (January 2007) result indicate that the turbidity of the sample was so high that the turbidity probe indicated an erroneous reading. Field parameters for all wells are also provided in Tables 2A through 2N. Recognizing that MW-3 was constructed in 1990, that the site soils have a naturally high arsenic content and that MW-3 is located in an area of the Site not associated with the recycling and smelting operations, the arsenic exceedances observed in MW-3 are believed to be a reflection of turbidity in the well and not water quality.

Although results of the groundwater sampling did not reveal site wide groundwater impacts, results did detect arsenic and lead above screening levels utilized for this project. Therefore, USEPA has requested that shallow groundwater be included as a component of the Corrective

Measures for the site. The Constituents of Concern for groundwater are lead and arsenic. The selected remedy for groundwater is monitored natural attenuation (MNA). Section 5.5.2 provides a description of the groundwater sampling to be performed as part of the MNA.

5.0 STATEMENT OF BASIS

5.1 GENERAL

The results of soil and sediment sampling conducted as part of the RFI and site specific risk assessment performed during the CMS have determined that lead is present in soil and sediment on the site at concentrations that could represent an unacceptable risk to future occupants and therefore; require corrective measures. The RFI sampling conducted in off-site areas identified concentrations of lead in surface soil and sediment greater than the USEPA Region 9 screening level for residential exposure to lead in soil and although a site specific risk assessment did not indicate a currently unacceptable risk within these areas, RMC has agreed to the USEPA's request to also perform corrective measures. Soil sampling performed as part of the Closure investigation also identified concentrations of lead and associated inorganic compounds in shallow subsurface soils beneath the pavement and floor slabs of the former indoor and outdoor waste piles. RMC must also close the storm water lagoon.

5.2 CORRECTIVE MEASURES

As stated above, the entire Site, except for those portions within the footprint of the HWMUs, is under the regulatory purview of the USEPA and was the subject of a Corrective Measures Study (CMS). The CMS included a human health risk assessment that evaluated specific non-residential exposure scenarios for the Site and proposed alternatives for remediation for review and consideration by the USEPA. The Corrective Measures alternatives selected in the Statement of Basis issued by the USEPA are the excavation of soil above a Remedial Action Level (RAL) calculated to achieve an exposure area wide Preliminary Remediation Goal (PRG) and consolidation of the remediated soil in an on-site containment cell.

The soil PRG calculated by the risk assessment for the Site is 920 mg/kg. The risk assessment evaluated the Site as "Grassy" and "On-Site" exposure areas (Figure 2) and using the results of RFI and Closure sampling calculated RALs as follows:

- 4,954 mg/kg total lead in "grassy" areas; and,
- 8,470 mg/kg total lead in paved areas.

A deed restriction against future residential or other development inconsistent with the risk assessment exposure assumptions will be filed with the Site deed.

For soil and sediment in off-site areas accessible to the general public, RMC has agreed to perform excavation activities to a remediation level of 400 mg/kg total lead. Attainment of the proposed remediation concentrations will be based on post excavation sampling. The protocol for performing the sampling and interpreting the results is provided in the CQAP (Attachment D). The procedures described are intended to be in general accordance with the IDEM RISC Technical Guidance for default closure sampling (RISC Technical Guidance Section 6.3).

5.3 HWMU CLOSURE

The HWMU areas are RCRA Subtitle C Interim Status units. As stipulated in the Consent Decree, the HWMU areas are being closed under the regulatory purview of the Indiana Department of Environmental Management (IDEM). RMC is proposing to perform the closure activities concurrent with the Corrective Measures and will be consolidating the remediated soils and sediment into the proposed on-site containment cell.

As documented in Advanced GeoServices Corporation's (AGC) September 24, 2008 letter to IDEM, it is RMC's intention to "clean close" the HWMUs. Based on the IDEM RISC Technical Guidance Industrial Default Closure Values, the target closure concentrations ("Standards") to be applied for the HWMUs are summarized as follows:

Parameter	Soil Standard	Groundwater Standard
Antimony	37 mg/kg	NA
Arsenic	20 mg/kg*	0.010 mg/L
Cadmium	77 mg/kg	NA
Lead	970 mg/kg**	0.042 mg/L
Selenium	53 mg/kg	NA

Notes:

*** The Soil Standard proposed for arsenic represents the "Direct Soil" value contained in RISC Industrial Closure Levels Table A (IDEM May 1, 2009). This value will be utilized over the default value of 5.8 mg/kg (based on Migration to Groundwater). Justification for use of the alternate value based on soil sampling which demonstrated a background arsenic concentration of 12.7 and site specific SPLP testing which demonstrates an average partitioning coefficient more than an order of magnitude greater than the portioning coefficient utilized to calculate the default Migration to Groundwater value. This represents a modification of the value for arsenic proposed in the September 24, 2008 letter to IDEM.**

**** The Soil Standard proposed for lead represents the "Construction" value contained in RISC Industrial Closure Levels Table A (IDEM May 1, 2009). This value will be utilized over the default value of 230 mg/kg (based on Migration to Groundwater). Justification for use of the alternate value is based on site specific SPLP testing which demonstrates an average partitioning coefficient more than an order of magnitude greater than the portioning coefficient utilized to calculate the default Migration to Groundwater value.**

Standards are not shown for barium, chromium, mercury or silver, as these parameters were not indentified during Closure sampling at concentrations greater than the default Industrial Closure Levels for soil or groundwater, as established under the IDEM RISC Technical Guidance (Last Revised May 1, 2009). Standards for antimony, cadmium and selenium are limited to values for soil only as none of these constituents was detected at concentrations above the their respective default Industrial Closure Levels for groundwater, as established under the IDEM RISC Technical Guidance (Last Revised May 1, 2009).

Attainment of the proposed closure levels within the HWMUs will be based on post excavation sampling. The protocol for performing the sampling and interpreting the results will be based on procedures contained in the IDEM RISC Technical Guidance for default closure sampling (RISC Technical Guidance Section 6.3). The target potential exposure concentration (PEC) for the bottom of the excavations will be 970 mg/kg total lead. Specific information regarding the closure sampling are provided in the CQAP (Attachment D), but in general the intent if to demonstrate that the 95-percent upper confidence limit (UCL) of the mean for the samples (collected randomly) representing a specific closure area is at or below the PEC.

5.4 CONTAINMENT CELL

Pursuant to the Statement of Basis issued by the USEPA, the containment cell will be situated in the northwest corner of the Site. The containment cell will be defined by a perimeter soil berm, have a soil bottom and be capped with a composite cap system. The composite cap will consist of (from top to bottom) a vegetative cover, erosion control mat, 6-inches of topsoil, 18 inches of compacted soil, double sided composite drainage net and a 60 mil textured geomembrane placed on a smooth, compacted soil subgrade. The drainage net will terminate in an anchor trench constructed in the perimeter soil berm. The anchor trench will contain a perforated pipe in a stone annulus designed to drain water from the drainage net to the surrounding ground surface. The specific materials to be utilized for the cap will be determined based on slope stability calculations and the final configuration of the cap. As a result of the change in the containment cell location required by the Statement of Basis, sufficient space is available to allow an increase in the size of the cell foot print from approximately 1.15 acres to 1.45 acres (as measured at the anchor trench). This 26% increase in area is expected to provide sufficient airspace (at the maximum 3:1 grading shown on Sheet 5, cell capacity will be approximately 26,200 cubic yards) to accommodate all the materials currently proposed for remediation and still provide additional excess capacity in case additional excavation is required. In the event the additional airspace it not required, the larger footprint will allow the finished containment cell to have a lower profile cap than the configuration shown on Sheet 5.

5.5 GROUNDWATER

Groundwater sampling conducted as part of the RFI has identified concentrations of arsenic in the shallow perched groundwater above the MCL of 10 ug/L on more than one occasion in MW-1, MW-2, MW-3, MW-7 and MW-8; and lead concentrations above 42 ug/L on more than one occasion in MW-2, and MW-7. The Statement of Basis issued by the USEPA, requires RMC place a deed restriction on the property against the use of groundwater from the Site as a potable water source. The Statement of Basis also selected Monitored Natural Attenuation (MNA) as the approach to restoring groundwater quality. MNA is predicated on an improvement of groundwater quality following completion of the proposed soil remediation activities. In addition RMC must install and sample a system of groundwater monitoring wells capable of monitoring groundwater quality in the vicinity of the containment cell for indications of groundwater degradation. A description of the proposed Containment Cell Groundwater Monitoring and the MNA Groundwater Monitoring is provided below.

5.5.1 Containment Cell Groundwater Monitoring

In preparation for implementing the CM Design, RMC will have groundwater monitoring wells MW-2S, MW-2D, MW-7 and MW-10 abandoned. Abandonment will be performed in accordance with the requirements of IDEM and Marion County Indiana. Simultaneous with the proposed abandonment, RMC will install four new overburden wells to monitor groundwater quality in the shallow perched zone beneath and in the general vicinity of the proposed containment cell. The proposed well locations, labeled as CC-1 through CC-4, are identified on Sheet 4 of the design drawings. The new wells and remaining existing wells will be surveyed by a professional surveyor retained by RMC to ensure all groundwater measurements are utilizing the same vertical and horizontal datum. The groundwater surface elevation obtained from the newly installed wells will be reviewed prior to start of corrective measures construction to confirm groundwater levels in the northwestern portions of the site are not above the proposed bottom elevation of the containment cell.

The containment cell wells (CC-1 through CC-4) will be subject to at least two rounds of groundwater sampling prior to and/or coincident with corrective measures construction and then routine monitoring following completion of corrective measures construction as part of long term Inspection and Maintenance activities.

5.5.2 MNA Groundwater Monitoring

As summarized in Section 4, groundwater sampling has identified concentrations of arsenic > 10 ug/L in MW-1, MW-2, MW-3, MW-7, MW-8 and MW-10; and concentrations of lead >42 ug/L in MW-2 and 7. Pursuant to the Statement of Basis, RMC will conduct sampling on the existing wells identified as having more than one elevated concentration for either lead or arsenic for the purpose of determining if concentrations are increasing, decreasing or stable, and to collect data regarding groundwater parameters that directly impact groundwater geochemistry.

The groundwater monitoring wells to be included as part of the MNA Groundwater Monitoring will consist of the following:

- MW-1 (arsenic);
- CC-1 (Intended as surrogate well for MW-2) (arsenic and lead);
- CC-4 (Intended as surrogate well for MW-7 and MW-10) (arsenic and lead);
- MW- 3 (arsenic); and,
- MW-8 (arsenic).

During installation of CC-1 and CC-4 soil samples will be collected for chemical analysis. Chemical analysis on the soil samples will include iron (ferrous and ferric), organic carbon, Ca, Mg, Na, K, Zn, alkalinity, nitrate and sulfate.

MNA Monitoring Wells will be sampled following completion of Corrective Measures during year 1, semi-annual during years 2 and 3, and annually during years 4 and 5, with the frequency after 5 years dependent upon the results of the sampling) for total and dissolved concentrations of arsenic and lead. In addition, one sampling event per year during years 1 through 5 will evaluate total concentrations of major ions (Ca, Mg, Na, K, HCO3/CO3, Cl, SO4, and NO3); and complexing ions (Fe2 and Fe3, Mn and Al), for possible future use in geochemical modeling, if required based on stability monitoring. Field parameters readings, including temperature, pH, Eh, DO, alkalinity, specific conductance and turbidity will be taken during every sampling round

Results (arsenic and/or lead as listed above) from the sampling performed in the MNA Groundwater Monitoring Wells will be evaluated using stability monitoring. The evaluation will utilize the Mann-Kendall test to evaluate trends in the data on a well by well basis to determine if the plume is expanding (concentrations increasing), shrinking (concentrations decreasing), or stable.

6.0 DESIGN ELEMENTS

6.1 PREPLANNING, PERMITTING, AND ACCESS

The selected Contractor will be required to provide a detailed construction schedule presenting his proposed approach to the project. The schedule with appropriate backup information will reflect the Contractor's approach to the project including the anticipated sequence of construction, estimated times for completion, assumed production rates, critical path and milestones. The schedule will also demonstrate their understanding of intrinsic design elements. The construction schedule will not be subject to regulatory approval, except to the extent the Contractor's approach or sequence may signficantly deviate from the Corrective Measures Design as currently proposed. Acceptance of the schedule by RMC will not be considered approval of a variance from the Corrective Measures Design or other requirements of the Contract unless specifically approved in writing by RMC. Copies of the schedule will be provided to the USEPA and IDEM prior to the start of work.

A pre-construction meeting between representatives from RMC, the Contractor, owners of property which will be remediated, and the appropriate Agencies will be held at the Site prior to the onset of active remedial activities. During the pre-construction meeting, the Contractor will present his approach to the project including schedule and sequence of work and address questions and concerns.

Remedial activities will not begin until the necessary permits are granted and required Notice of Intent (NOI) letters (erosion and sediment control) have been submitted to and approved by IDEM. A list of the required permits has been identified and is included in Section 7.0.

Access to off-site areas requiring remediation will be secured prior to the onset of corrective measures. Amtrak and CSX were contacted during preparation of the Pre-Final Design to determine limitations and restriction associated with excavation or construction activity within railroad right-of-ways and to discuss any additional considerations regarding work in close proximity to their tracks. Through those contacts, it was confirmed that CSX is the owner of the right-of-way for the tracks north of the site and Citizens Gas; however; information received from Amtrak indicates that they do not own the tracks between Big Four Road and the Citizens Gas fence. A review of the Marion County Indiana Tax Assessors office determined that the property between the southern fence for Citizens' Gas and Big Four Road is owned by Citizens Gas.

Relative to work in the CSX right-of-way, RMC is providing additional design details for their review. The proposed excavation is a minimum of 25 feet from the closest rail and the depth of proposed removal are outside the "theoretical railroad embankment line" (a 1:1.5 line that extends out and down from a point located 12 feet from the centerline of the track) that would require sheeting and shoring. Requirements for the access by equipment and personnel between the tracks and proposed excavation will also require that the Contractor carry specific railroad insurance and have a CSX approved flagman present during the work to control access and train traffic. To protect the track in the property owned by Citizens Gas, no excavation will be performed within the theoretical railroad embankment line. The theoretical railroad embankment line has been plotted on excavation cross-sections provided on Sheet 12.

Work within the right-of-way of South Arlington Avenue will require that the contractor obtain a right-of-way permit. Typically these would be issued through the City of Beech Grove but because South Arlington Avenue is identified as a "primary arterial road" additional approval from the City of Indianapolis may be necessary, but a final determination has not yet been received.

6.2 SITE PREPARATION, DUST CONTROL AND STORM WATER MANAGEMENT DURING CONSTRUCTION

Site preparation activities will include establishment of the support zone, installation of erosion control measures, implementation of dust control measures and air monitoring, mobilization and activation of temporary water treatment equipment and utility location and abandonment, as needed. Exclusion and contaminate reduction zones will be designated to mitigate cross contamination. Equipment and personnel decontamination stations will be instituted to minimize the potential of contaminant release. Traffic routes and access will be established for transport of contaminated materials between excavation areas and the containment cell.

Clearing and grubbing of the containment cell location and other excavation areas within the northern wooded area will be required to facilitate equipment access. Roadways will need to be established for material transport. These areas will require grading such that erosion and sediment control is maintained.

Dust control measures will be selected by the Contractor based on the means and methods proposed for completion of the project. In general these are expected to include the use of water to wet the ground surface and areas of excavation. During decontamination and demolition activities the contractor utilized large spray- misters that utilized fans and water spray to wet the work zone in the surrounding area and to help suppress dust. The contractor also utilized a water truck on a nearly continuous basis during dry weather to keep site pavement wet. Section 02115 of the Specifications provides additional information related to dust control and Section 02999 provides requirements for dust control and air monitoring.

Storm water management and erosion controls will be performed in accordance with applicable standards and practices as set forth in the Indiana Storm Water Quality Manual and the Indianapolis Storm Water Design and Construction Specifications Manual. Storm water during construction activities can be characterized as follows: storm water runoff from areas of exposed soils and sediment requiring remediation (i.e. active excavations) and storm water from areas not designated for remediation or where remediation is already completed (i.e. "clean areas").

Storm water associated with active excavations, and decontamination water, will require collection and treatment prior to discharge to the POTW through an existing sanitary sewer. Collected water requiring treatment at a minimum will be processed through a series of bag filters. The Contractor will determine the exact configuration and filtration requirements necessary to meet the discharge requirements established by the POTW and determine if additional treatment is necessary. Storm water and decontamination water will be treated in batches and stored in tanks until approved for discharge by the Engineer based on analytical results. The maximum batch size shall be 30,000 gallons. The maximum discharge rate to the POTW will be 90 gallons per minute or as otherwise dictated under the Special Discharge Permit. The limits for discharge of water to the POTW will be established under the Special Discharge Permit and therefore the exact parameters and values can not be determined at this time. However, for comparison purposes the following parameters and limits were required for the decontamination and demolition activities:

- pH 5.0 to 12.0 S.U.
- Arsenic 4.0 mg/L
- Lead 4.7 mg/L
- Zinc 36.0 mg/L
- TPH 200 mg/L

Storm water from the clean areas will not require collection and management, except to the extent required to control erosion and avoid entry into active excavations and work zones. The Contractor will utilize the existing pump and piping system to convey clean storm water runoff from the existing sump areas to a discharge location designated by RMC. The precise location will be dependent upon the final requirements for storm water management between completion of decontamination and demolition activities and the start of the Corrective Measures. The Contractor will sequence his work to ensure the four pump houses will remain in operation as long as possible during construction or he will establish new temporary pumping to continue water management.

The lagoon will cease to be used for storm water management when closure of the lagoon begins. The current paved surfaces at the Site have been cleaned as part of the decontamination and demolition project and are approved for discharge without treatment. If an area contributing runoff to one of the pump houses or collection area established by the Contractor becomes re-contaminated, the Contractor will be required to analyze the accumulated water from that pump house and demonstrate the water still meets the appropriate discharge criteria. If the water does not meet the discharge criteria the Contractor will be required to collect and treat all storm water flowing to that pump house.

Storm water from the "grassy" areas, will continue to be managed by utilizing existing drainage features such as the perimeter swales. The construction within the grassy areas and swales will be sequenced such that remediation in the upslope areas is completed before down slope areas. This will help prevent recontamination. The design is also expected to require restoration of remediated swales using grass sod or other measures that will allow immediate restabilization of the remediated areas.

6.3 CONTAINMENT CELL CONSTRUCTION

The containment cell will be situated in the northwest corner of the Site, as shown on Sheet 5 of the design drawings. The containment cell will be 350 feet long by 180 feet wide defined by the centerline of an 8 feet wide earthen berm. The berm will have a top of berm elevation of 840.0 and an interior bottom elevation of 838.0. The interior bottom elevation has been selected to optimize airspace and based on the existing 838 contour that crosses the proposed containment cell footprint. A review of potentiometric groundwater maps shows the groundwater elevation within the vicinity of the proposed containment cell (primarily MW-10) varies between 833.24 (October 2007) and 841.25 (April 2005). Based on a direct comparison, this means the groundwater may range from 4.76 feet below to 3.25 feet above the proposed cell bottom elevation. However, a review of topographic information identifies a discrepancy between the datum utilized for the groundwater wells and the datum utilized for the topographic map. In general, surrounding borings located by the Surveyor who established the well elevations indicate a difference on the order of 1.9 feet, with the Surveyor's elevations being higher than the topographic map. Unfortunately, insufficient time was available to resolve this conflict prior to submission of the Pre-Final CMD. During completion of the Final Design, the bottom of cell and groundwater elevations will be re-evaluated and the bottom elevation possibly modified. Considering the low solubility of the constituents of concern and the knowledge that final cap will be impermeable (thus preventing the infiltration of water through the placed materials), impact to groundwater by the contents of the cell is not expected to be a concern.

Proposed finished grades will be no steeper than 3 horizontal to 1 vertical (33%) and no flatter than 33 horizontal to 1 vertical (3%). The maximum proposed elevation of the top of cap will be 858 +/-. The grading shown on Sheet 5 of the design drawings for the top of waste and top of cap represents the maximum filling configuration and provides a waste disposal capacity of approximately 26,200 cubic yards. The total combined volume of soil, sediment and miscellaneous debris to be excavated is approximately 18,000 cubic yards. This includes approximately 5,000 cy of soil from the HWMUs, 6,000 cy of soil from other on-site areas, 5,000 cy of on-site debris and 2,000 cy of off-site soil and sediment.

The containment cell berm will be located 30 feet from the northern and western property boundaries as measured from the centerline of the proposed berm. The area between the berm and property line will be utilized to accommodate a swale to convey and manage storm water runoff from the west and north sections of the containment cell cap. The remainder of the cap and storm water from the majority of the former manufacturing area will be routed through a storm water management basin located east of the cell.

Construction of the cell will require minor grading to create the swale and berm. Exisitng groundwater monitoring wells in the area (MW-2s and 2D, MW-7 and MW-10 will be abandoned by RMC prior to the start of Corrective Measures construction. Existing trees will need to be cleared and grubbed and the existing topsoil layer will be stripped prior to the start of grading. Cleared material (trees and shrubs) that have not become cross-contaminated with site soils and sediment will be chipped and sent off-site for use in the manufacturing of mulch, wood chip products, or supplemental fuel. Grubbed material will be chipped and stockpiled for subsequent placement in the containment cell. Topsoil and excess native soil (remaining after the proposed cutting and filling) will be stockpiled separately and sampled to determine total lead content. Those materials demonstrated to be <400 mg/kg total lead will be approved for unrestricted use on the Site. Those materials >400 mg/kg but <920 mg/kg total lead (The calculated PRG) will be approved for use during backfill and restoration on the Site except in proposed drainage and storm water management features and former SWMUs where only materials <400 mg/kg may be used. Materials shown to be >920 mg/kg total lead will be placed in the containment cell.

Containment cell filling will be performed in lifts. Lifts will have a maximum loose lift thickness of 18-inches and each lift will be compacted until visually stable as determined by the Engineer. Filling will be sequenced to contain storm water runoff from the exposed waste surface and the contractor will be required to collect and treat standing water prior to placement of subsequent lifts. Access into the cell will be provided from the south end and equipment entering the cell and running across areas of exposed soil will be required to clean the wheels before exiting the cell. The Contractor will be encouraged to utilized designated equipment in the cell and dump materials destined for the cell without actually entering the cell.

6.4 HAZARDOUS WASTE MANAGEMENT UNIT CLOSURE

6.4.1 Surface Impoundment

The surface impoundment (lagoon) is an Interim Status RCRA Hazardous Waste Management Unit (HWMU) that is subject to the Closure requirements contained in 40 CFR 265.228. The Contractor will remove standing water in the lagoon for treatment through the temporary water treatment system. The accumulated sediment and vegetation will be removed and placed in the on-site containment cell. Throughout sediment removal the Contractor will continue to collect and treat water draining from the sediment. After removal of liquid, bulk sediment, vegetation, the liner and miscellaneous debris, the Contractor will demolish the concrete component of the liner. Demolition of the concrete liner will work from the perimeter and work inwards taking care to minimize disturbance to the subsoils. Demolished concrete will be segregated, sized (,6-inches), stockpiled, sampled for lead and arsenic and utilized for crushed aggregate during surface stabilization/restoration..

Previous sampling of soil beneath the concrete liner produced results that were all below the action levels being applied to closure of the HWMUs except for a single sample (CSB-37 A (0-3 inches)) which had an arsenic concentration of 25 mg/kg. This result is only slightly above the action level for arsenic of 20 mg/kg and in consideration of the associated lead result of 58 mg/kg is believed to be a reflection of variability in background arsenic concentrations rather than impacts from former facility operations. Therefore, no soil remediation is proposed within the footprint of the lagoon. The Engineer will collect soil samples from the soil immediately beneath the concrete following the procedures established in the CQAP. The results will be evaluated as confirmatory samples against the action levels established for the HWMUs.

Following receipt of acceptable confirmatory sampling results, the footprint of the lagoon will be backfilled. Backfilling will be performed by cutting down the southern and eastern portions of the lagoon embankment and using the resulting soil as fill. Topsoil must be stripped from the embankment prior to cutting, as topsoil will not meet the geotechnical requirements for soil backfill. Soil used as backfill will be placed in lifts and compacted in accordance with the project earthwork specifications. The finished surface will be graded to prevent ponding of water.

6.4.2 Former Waste Pile Locations

Those areas of the Site utilized for the management of feed materials for the recycling operation and resulting solid waste materials were designated as waste piles in the facility Part A filing and granted interim status under RCRA. The waste pile areas were subject to focused sampling as part of the Closure Investigation and were also subject to a limited amount of additional sampling as part of the site wide RCRA investigation. The locations and results of the borings are provided on Sheets 2 and 3 of the design drawings, respectively. Additional discussions of the design elements for the former waste piles are provided separately below based on those that were indoors and those that were outdoors.

6.4.2.1 **Outdoor Waste Piles**

The Outdoor Waste Piles consist of six separate areas (number 1 through 6) as shown on Sheet 1 of the design drawings. The total combined area of the Outdoor Waste Piles is approximately 1.8 acres. Records indicate that the outdoor waste piles were originally utilized to store lead bearing materials waiting processing recycling and waste products (primarily slag) awaiting off-site disposal. The existing ground surface of the outdoor waste piles is characterized by bituminous concrete (asphalt) or Portland cement concrete pavement. The only remnant structures within the footprint of the Outdoor Waste Piles are two former equipment pedestals in area 1 (near the northwest corner of the MSB) and area 5, the former loading dock of the MSB. During the recent facility demolition, all paved site surfaces were cleaned to remove debris and sediment.

Thirty-one soil borings were conducted within the footprint of the Outdoor Waste Piles as part of the Closure Investigation plus seven borings performed as part of the RFI. To meet the closure criteria established for the HWMUs, soil remediation will be required at the areas depicted on Sheet 6 of the design drawings. As shown, depths range from no removal to 7.25 feet, as measured from the existing ground surface.

Closure of the Outdoor Waste Piles will consist of removing the pavement covering the area to be remediated and selective excavation of the underlying soil to the target removal depths. Spot elevations will be obtained at designated locations on the existing ground surface, prior to removal of the pavement and utilized as control points to guide the depth of excavation activities. The removed pavement, consisting of asphalt and/or concrete will be segregated and crushed for possible reuse as excavation backfill, and soil will be placed in the Containment Cell in lifts and compacted to provide a stable surface. Confirmatory sampling will be performed at the bottom of the excavations and along side walls that are inside the footprint of the HWMUs to document attainment of closure criteria in accordance with the procedures established in the CQAP (Attachment D). Because of the different standards required by IDEM for closure of the HWMUs and USEPA for Corrective Measures on the remainder of the site, sidewall sampling will not be performed along sidewalls that coincide with the boundaries of the HWMUs where the exterior boundaries are not adjacent to other HWMUs. Concrete that has been segregated and crushed will be sampled to determine the acceptability of the material for re-use as excavation backfill.

Following approval of confirmatory sampling information by the Engineer, the resulting excavation will be backfilled with crushed stone or soil to the proposed finished grades. Materials utilized for backfill within the limits of the Outdoor Waste Piles shall be imported fill certified "clean" by the source with appropriate analytical testing to document the certification. The Contractor will protect the remediated area against cross contamination from surrounding areas.

6.4.2.2 **Indoor Waste Piles (Material Storage Building)**

The indoor waste piles were located in the Material Storage Building (MSB). The MSB was located at the north end of the main building (see Sheet 1). The MSB was approximately 165 feet by 165 feet with an enclosed corridor into the adjacent Furnace Room. The interior of the MSB included multiple bins used to store lead battery components awaiting processing through the furnace and various other raw materials (such as coke, iron and limestone or crushed concrete) also used in the smelting process. The MSB had concrete floors (typically 6 to 8 inches thick) sloped to drain from the exterior walls inward. During the various investigation activities, the concrete floor was observed to be degraded in the north central portion of the building, presumably a result of the acid in the lead battery feed material reacting with the concrete. The areas of greatest degradation coincide with the areas of proposed deepest excavations as shown on Sheet 6 of the design drawings.

As part of the recently completed decontamination and demolition activities, the 4 to 5 feet high concrete walls forming the exterior of the building and defining the interior bins were demolished to grade. The floor was filled with up to 18 inches of concrete rubble from other areas of the site that had been cleaned and crushed and then covered with a 20 mil PVC geomembrane. The crushed concrete was placed to create positive drainage for precipitation falling on the PVC geomembrane to the storm water collection system. The geomembrane is protected against wind uplift by approximately 300 to 400 sand bags. An estimated 500 to 600 cubic yards of crushed concrete rubble were placed over the MSB floor.

Closure of the indoor waste pile is expected to be one of the initial remedial activities to be performed after preparation of the disposal cell. Closure will consist of removing the PVC geomembrane and excavation of the crushed concrete rubble; removal of the concrete floor and excavation of underlying soils to the depths specified on Sheet 6 of the design drawings. The removal of the geomembrane, crushed concrete rubble and concrete floor will be performed in sections of a size to be determined by the Contractor based on his means and methods for construction. The geomembrane will be cut into sections no larger than 30 feet by 30 feet and placed flat (panels may be folded but crumpled) in the bottom of the containment cell. The crushed concrete rubble and debris resulting from removal of the floor will be placed in the Containment Cell in loose lifts not to exceed 18-inches thick. Each lift will be compacted to provide a stable surface before the placement of subsequent lifts.

"Soil" removal within the MSB will be to a minimum depth of 12-inch (as measured from the top of the concrete pad) over the entire MSB footprint with specific areas as shown on Sheet 6 of the design drawings to depths as great as 72-inches. The total estimated removal volume within the MSB (excluding the rubble placed during decontamination and demolition) will be approximately 1,400 cubic yards (cy); including 700 cy of concrete representing the floor and 700 cy of soil and crushed aggregate excavated from beneath the concrete floor. The Contractor will be required to obtain spot elevation from the top of the concrete floor prior to removal for use in controlling depth of excavation. Confirmatory sampling will be performed at the bottom of the excavations and along side walls that are inside the footprint of the HWMUs to document attainment of closure criteria. Sidewall sampling will not be performed along sidewalls that coincide with the boundaries of the HWMUs where the exterior boundaries are not adjacent to other HWMUs.

Following approval of confirmatory sampling information by the Engineer, the resulting excavation will be backfilled with crushed stone or soil to the proposed finished grades. Materials utilized for backfill within the limits of the MSB and other SWMUs shall be clean imported fill certified "clean" by the source with appropriate testing. The Contractor will protect the remediated area against cross contamination from surrounding areas.

6.5 ON-SITE CORRECTIVE MEASURES

On-site corrective measures pertain to non-HWMU soil and "sediment" in the excavation areas located within RMC property boundaries as presented in Sheet 7 of the design drawings, excluding excavation within public and railroad right-of-ways. Non-HWMU soil excavation areas included the former manufacturing area (referred to as "on-site area" in the BHHRA), lawn and wooded area (referred to "grassy area" in the BHHRA) of the Site that are outside of the HWMUs and exceed the calculated RALs of 4,954 and 8,470 mg/kg total lead, respectively. Although referred to as "sediment", the non-HWMU sediment excavation areas are generally mowed lawn on the site and small shallow storm water ditches with little or no actual sediment present in these features and the samples designated as "sediment" were most typically soil.

6.5.1 Soil Excavation

Excavation of on-site soils will require the removal of overlying floors and pavement in areas where subsoils exceed the RAL. Floors and pavement will be removed in a manner that minimizes disturbance of underlying soils. The rubble, consisting of asphalt and/or concrete, will be segregated and crushed for potential use as excavation backfill. Sampling will be required to determine if the rubble meets backfill standards (see Specification Section 02210). Any rubble that does not meet the Specifications will be placed in the containment cell. The areas of floor and pavement to be removed will be limited to only those areas requiring removal of subsoils. The Contractor shall provide sufficient dust control measures to ensure that the requirements for dust control identified in the Specifications and CQAP are met.

Soil excavation activities will be performed using commonly available construction techniques and readily available equipment and qualified labor. As required by the Specifications, the Contractor shall utilize appropriately placed silt fence, construction sequencing, storm water diversion and similar techniques to protect against erosion and transport potentially contaminated sediment from the site.

The Contractor will be required to develop specific measures to minimize the potential release of contaminants during excavation and exposure of on-site workers and off-site individuals in the immediate vicinity of the Site. Engineering controls such as staged construction, water misting for dust suppression, and proper use of personal protective equipment will be employed to mitigate exposures and potential releases during excavation.

6.5.2 Sediment Excavation

Excavation will be performed within the northern drainage ditches and the driveway ditch to remove "sediment" exceeding 400 mg/kg total lead. (As stated above the drainage swales are generally mowed lawn on the site and small shallow storm water ditches along the CSX railroad tracks). Little or no actual sediment was present in these features. The samples were designated as "sediment" because they came from the bottom of the drainage swale, not because they represented significant bed load in the drainage ditch.

The northern drainage ditches are located along either side of the abandoned RMC railroad spur in the wooded area to the north. Historic activities are assumed to have conveyed surface water from the Site to the drainage ditches, depositing lead impacted solids along their span. The drainage ditches continue to receive storm water from the Site and flow north toward the CSX railroad line to the north. Three check dams consisting of geotextile and stone are located along the ditches. The check dams trap sediment upstream under current flow conditions and allow the passage of storm water downstream. Excavation in this area includes removal of the check dams within the lateral extents of the ditches. The stone, geotextile and accumulated sediment within the check dam will be placed in the containment cell with the remediated sediment/soil. The drainage ditches are located within a heavily wooded area and will require clearing to facilitate equipment access. Excavation to a depth of 12 inches and extending 10 feet about the centerline of the ditches is expected to achieve sufficient remediation. Sediment excavation may require dewatering of the ditches and water removed during excavation will require treatment prior to discharge or diversion. Sediment control measures may be required to reduce the potential for further contaminant migration during excavation.

The driveway ditch is located along the northern side of the main entrance to the Site, off of South Arlington Avenue. Boundaries of the ditch are fairly well defined in areas, and the area of proposed excavation is intended to include the ditch and the adjacent lawn area. The area continues to receive surface drainage and removal of standing water may be required prior to or during the course of excavation. Water removed during excavation will require treatment prior to discharge. Sediment control measures may be required to reduce the potential for contaminant migration during excavation.

Excavation in these areas will be performed using commonly available construction techniques and readily available equipment and qualified labor. The Contractor shall implement Best Management Practices (BMPs) during and after excavation activities to prevent erosion.

6.6 OFF-SITE CORRECTIVE MEASURES

Off-site corrective measures are presented in Sheets 7 and 8 of the design drawings and pertain to proposed excavation areas: within the mowed lawn drainage ditch along South Arlington

Avenue, mowed lawn section of the Citzens Gas property between Big Four Road and Citizens Gas fence line; and within portions of the northern drainage ditch outside of the RMC property boundary along the CSX right-of-way; and on the Citizens Gas property.

6.6.1 Remediation in Public Right-of-Ways

As shown on Sheet 7, approximately 1,500 feet of the mowed lawn drainage feature along South Arlington Avenue will require excavation of soil/sediment exceeding the USEPA residential screening level of 400 mg/kg. Excavation will extend from the edge of pavement to the RMC fence line at varying depths of 6 to 18 inches, with depths generally increasing from north to south. Excavations along the South Arlington Avenue pavement deeper than 6 inches will be stepped in 6-inch increments to avoid damage or undercutting of the road way.

Remedial activities along South Arlington Avenue will involve use of the roadway for equipment access and material transport. As identified in this Design Report, a Right-of-Way permit will be required for this work. Under such permit, traffic control measures shall be implemented by the Contractor in accordance with the Indiana Manual of Uniform Traffic Control Devices. At a minimum, traffic control devices shall be installed prior to commencement of operations, be properly maintained and utilized during excavation activities, and be removed immediately upon completion. Careful consideration of excavation approaches will need to be exercised in this area due to the presence of overhead and subsurface utilities.

Careful planning with regard to weather forecasts and incorporation of erosion control techniques will be essential as this area receives considerable surface drainage.

6.6.2 Remediation Within Railroad Right-of-Ways

As shown in Sheets 7 and 8, remediation within railroad right-of-ways includes excavation along the CSX line north of the Site and the tracks along Big Four road, in the property owned by Citizens Gas.

Remediation in the CSX railroad right-of-way consists of removal of sediment exceeding 400 mg/kg total lead within the drainage ditch paralleling the tracks, extending approximately 600 feet west of the northwest corner of the RMC property. Excavation in this area will necessitate proper identification of utility locations prior to commencement. Postings indicate that a Fiber Optics line is located along the tree line in this area. Excavation will be performed using conventional construction equipment. Dewatering of the swale and inclusion of sediment control methods may be necessary to facilitate excavation. Due to the geography of the area and close proximity to the tree line, additional clearing may be necessary to access for excavation. Access may best be achieved from the containment cell location.

6.7 CONTAINMENT CELL CAPPING AND CLOSURE

The final grading of the cap will be dictated by the actual volume of soil, sediment and debris placed, but the maximum grading will not exceed that shown on Sheet 5 of the design drawings. Maximum slopes will be 33%. As filling progresses to elevations above the top of berm, the Contractor will be required to place temporary diversions to intercept storm water runoff from the exposed materials in the cell and convey that water to the temporary treatment system for processing. When final grades are reached, the finished surface will be smooth graded and protruding rocks or other objects that could puncture the geomembrane will be remove by the Contractor. Following approval of the finished surface by the Engineer, the Contractor will be required to protect the area against vehicular traffic except to the extent necessary to deploy the liner components. Any damage to the approved surface will be repaired by the Contractor to the satisfaction of the Engineer prior to geomembrane placement. The approved surface may be temporarily covered with plastic sheeting or non-woven geotextile until mobilization of the liner installer, provided such measures protect the surface against erosion. Any such temporary cover must be adequately balanced to protect against disturbance by wind or other causes.

The proposed cap will be a composite system consisting of a textured 60 mil HDPE geomembrane (Cap Barrier Layer) placed directly on the approved soil surface; double sided drainage net (Cap Drainage Layer); 18-inches of compacted soil fill; 6-inches of topsoil; erosion control mat; and vegetative cover. The geomembrane and drainage net components of the cap will terminate in an anchor trench in the top of the berm. Infiltrating precipitation intercepted by the drainage net will be collect in a perforated pipe situated within the anchor trench. The perforated pipe will have outfalls periodically around the perimeter of the berm to discharge collected water. Specification Section 02751 provides requirements the Cap Drainage Layer; and Section 02755 provides requirements for the Cap Barrier Layer.

6.8 BACKFILL AND RESTORATION

6.8.1 On-Site Backfill and Restoration

Following completion of remediation, the Site areas will be regraded to allow surface water to runoff from the site to the drainage ditches along the CSX right-of-way and South Arlington Avenue without the use of the pump houses. Existing pavement will remain in the areas of the site not proposed for soil remediation except to the extent required to facilitate post remediation storm water drainage. Finished grading is not included as part of the Preliminary Corrective Measures Design. The finished surface on-site will be restored with vegetation on and in the immediate vicinity of the containment cell and with clean concrete rubble or crushed stone on the remainder of the Site. On-site drainage ditches will be lined with rip-rap stone. Information regarding the physical and analytical requirements for aggregate and soil used for restoration are provided in the Specifications.

6.8.2 Off-Site Backfill and Restoration

Off-site areas will be restored to the pre-remediation condition unless otherwise approved by the property owner. Backfill will consist of imported structural soil and stone and imported topsoil and/or sod. The drainage ditch along South Arlington Avenue will be restored using sod. The drainage ditches along the CSX right-of-way will be restored using rip-rap stone in the bottom and railroad ballast on the embankment and surrounding ground surface. Information regarding the physical and analytical requirements for aggregate and soil used for restoration are provided in the Specifications.

7.0 PERMITTING REQUIREMENTS

This section describes federal, state, regional, and local permits and approvals required for implementation of Corrective Measures. This section also discusses site access and easement agreements or other arrangements with adjoining landowners necessary for implementation of Corrective Measures. A discussion of the application requirements and timeline for each item is provided below.

7.1 FEDERAL PERMITS

At this point in time, no federal permits are anticipated.

7.2 STATE PERMITS

7.2.1 Rule 5 – General National Pollutant Discharge Elimination System (NPDES) Permit for Storm Water Run-off Associated with Construction Activity

Indiana Administrative Code Rule 5 (327 IAC 15-5) is a performance-based regulation designed to reduce pollutants that are associated with construction and/or land disturbing activities. The requirements of Rule 5 apply to all persons who are involved in construction activity (which includes clearing, grading, excavation and other land disturbing activities) that results in the disturbance of one (1) acre or more of total land area.

RMC will submit application under Rule 5, which will include the following:

- Notice of Intent Letter
- Construction Plan

- Project Narrative and supporting documents
- Vicinity Map
- Existing Project Site Layout
- Final Project Site Layout
- Grading Plan
- Drainage Plan
- Storm Water Pollution Prevention Plan
- Post Construction Storm Water Pollution Prevention Plan

7.3 CITY OF INDIANAPOLIS PERMITS

7.3.1 Office of Code Enforcement

7.3.1.1 **Drainage**

The Office of Code Enforcement (Office) requires that land alterations be compliant with standards and practices that result in proper storm water drainage and sediment control. The Office has indicated through conversation with AGC that a Mass Earthwork Permit may apply for CMI. The Mass Earthwork Permit is a drainage permit for projects involving earth disturbance without the construction of buildings. As a general rule, all land alterations in industrial developments require:

- Storm water permit application
- Storm water plans
- Technical information report
- Sediment and erosion control plan
- BMP operation and maintenance manual

As per the Office, construction observation services, testing, and 'record' drawings shall be provided for all industrial developments that plan land disturbance of 5 acres or more.

Once construction begins, the Contractor will be responsible for informing and/or notifying the Office's observer assigned to the following:

- Daily work schedule including any changes in schedule
- Prior notification if work is to be performed on weekends and/or holidays
- Date mandrel tests are to be performed
- Date 'as-built' verification is to be performed

The Office, upon request of the Contractor and/or owner, will schedule the final inspection.

As per Office direction, RMC will submit application for a Drainage Permit which will include completion of the following forms:

- Certification Sufficiency of Plan (Drainage)
- Certificate Obligation to Observe (Storm Water)
- Infrastructure Plan Review Submittal

Upon review of RMC's submission, the Office will determine if the Marion County Soil and Water Conservation District will be involved in the review process. Upon approval, the Office will provide RMC with an Approval Letter, which will need to be included in RMC's Notice of Intent (NOI) submittal to the Indiana Department of Environmental Management (IDEM) for Rule 5 General Construction NPDES Permit application.

7.3.1.2 **Improvement Location Permit**

Temporary office trailers will be required to support CMI activities. A permit will not be required for these trailers as the Office designates "movable, temporary use structures or buildings utilized during construction projects" as specific exemptions that do not necessitate an Improvement Location Permit. However, the Office stipulates that all provisions and regulations of the City of Indianapolis Industrial Districts Zoning Ordinance shall continue to apply to exempted structures and improvements.

7.3.1.3 **Right-of-Way Permit**

RMC will submit application for excavation within the South Arlington Avenue public right-of-way which will include, at a minimum, the following:

- A properly executed permit application, in the form designated by the Division, including but not limited to, the following information:
  - The name and address of the contractor responsible for work;
  - The nature of, and the reason for, the work to be performed;
  - The location of the worksite and the dimensions of the excavation;
  - The anticipated length of time to complete the work;
  - The method of traffic control to be used by the applicant at the worksite;
  - An indemnification agreement; and,
  - Any other pertinent information requested by the Department/Division.
- A general liability insurance policy.

- A performance and maintenance bond.

- Approval from the Department/Division if the proposed work involves a sanitary sewer, storm sewer, affects drainage within the public right-of-way, or as required.

7.3.2 Department of Metropolitan Development

7.3.2.1 **Industrial Districts Zoning Ordinance**

The Site is designated as a I-3-S Medium Industrial Suburban District and I-4-S Heavy Industrial Suburban District and the Official Thoroughfare Plan for Marion County designates South Arlington Avenue as a Primary Arterial. The proposed containment cell will fall in both the I-3-S and I-4-S zoning districts. Although not representing a "structure" as defined under the zoning regulations, we have situated the cell to provide 30 feet of set back from the north and west property lines which represent the side and back yards of the property respectively. The setback from South Arlington Avenue, as measured from the centerline of the proposed berm will be approximately 190 feet at its closest point. The areas within the setbacks will be utilized as storm drainage and storm water management controls.

The containment cell does not appear to represent a "use" under the Industrial Zoning Ordinances, although both zoning districts include provisions for "industrial waste disposal facilities." The Performance Standards for both districts state that plans and specifications for proposed industrial waste disposal facilities shall be submitted to, and written approval obtained from, IDEM and the City of Indianapolis, Division of Compliance before an Improvement Location Permit will be issued. The City of Indianapolis, Division of Compliance will be contacted to obtain further information regarding siting of the containment cell.

7.4 CITY OF BEECH GROVE PERMITS

Conversations with the City of Beech Grove and the City of Indianapolis indicate that, due to the nature of corrective measures, jurisdiction of the majority of work to be performed will be with the City of Indianapolis, Division of Compliance.

8.0 PUBLIC RELATIONS

Refined Metals Corporation (RMC) developed a Community Relations Plan as an attachment to the RFI Work Plan and has been implementing that plan since. Components of the existing Community Relations Plan include maintaining a document repository (currently located at the Beech Grove Public Library), issuing semi-annual news letters to a specified mailing list, maintaining open communications with local officials, and conducting public meetings when warranted based on the level of public interest. During preparation of the Final Corrective Measures Design RMC will evaluate and revise the existing Community Relations Plan as appropriate for the proposed Corrective Measures.

9.0 SCHEDULE AND COST ESTIMATE

9.1 SCHEDULE

Based on the corrective measures activities anticipated by this Preliminary Corrective Measures Design, RMC is anticipating a construction period on the order of 4 to 6 months, although ultimately schedule will be dictated by the approach of the selected contractor. A critical path style schedule has been developed and is provided as Attachment G.

9.2 COST ESTIMATE

A preliminary construction cost estimate is provided as Attachment F. The construction cost estimate will be finalized as part of the Final CMD submission. The cost estimate has been developed using a unit price and estimated quantity format. As shown, the preliminary estimate is $1,046,756.

10.0 POST CORRECTIVE MEASURES STORM WATER MANAGEMENT

Post corrective storm water management will consist of a gravity storm water system that will convey storm water runoff from the former impervious manufacturing areas of the site and the eastern portion of the proposed containment cell cap through a storm water management basins situated along the east side of the proposed containment cell. The storm water management basin will cover approximately 1.24 acres and have a storage capacity of approximately 100,000 cubic feet. The outlet structure will be a 15-inch diameter reinforced concrete pipe with an invert elevation of 837.0 that discharges into the railroad ditch along the CSX property. The proposed discharge towards the north coincides with the original storm water discharge for the manufacturing areas of the site prior to construction of the storm water collection and treatment system.

Swales will convey the storm water runoff from the restored areas of the site to the storm water management basin as shown on Sheet 6. The total drainage area to the basin is 9.5 acres with an average CN value of 91. Pondpack® was utilized to perform the storm water management calculations following the SCS Unit Hydrograph Method. As presented on the calculations (Attachment C), the basins will detain the storm event and attenuate the flows as follows:

DESIGN STORM	INFLOW (cfs)	OUTFLOW (cfs)	ELEVATION (ft)	STORAGE (Ac-ft)
2	24.9	1.91	837.86	0.758
5	37.31	3.34	838.19	1.156
10	43.51	4.09	838.3	1.354
25	52.78	5.23	838.60	1.651
50	58.93	5.98	838.76	1.848
100	68.12	7.03	839.00	2.144

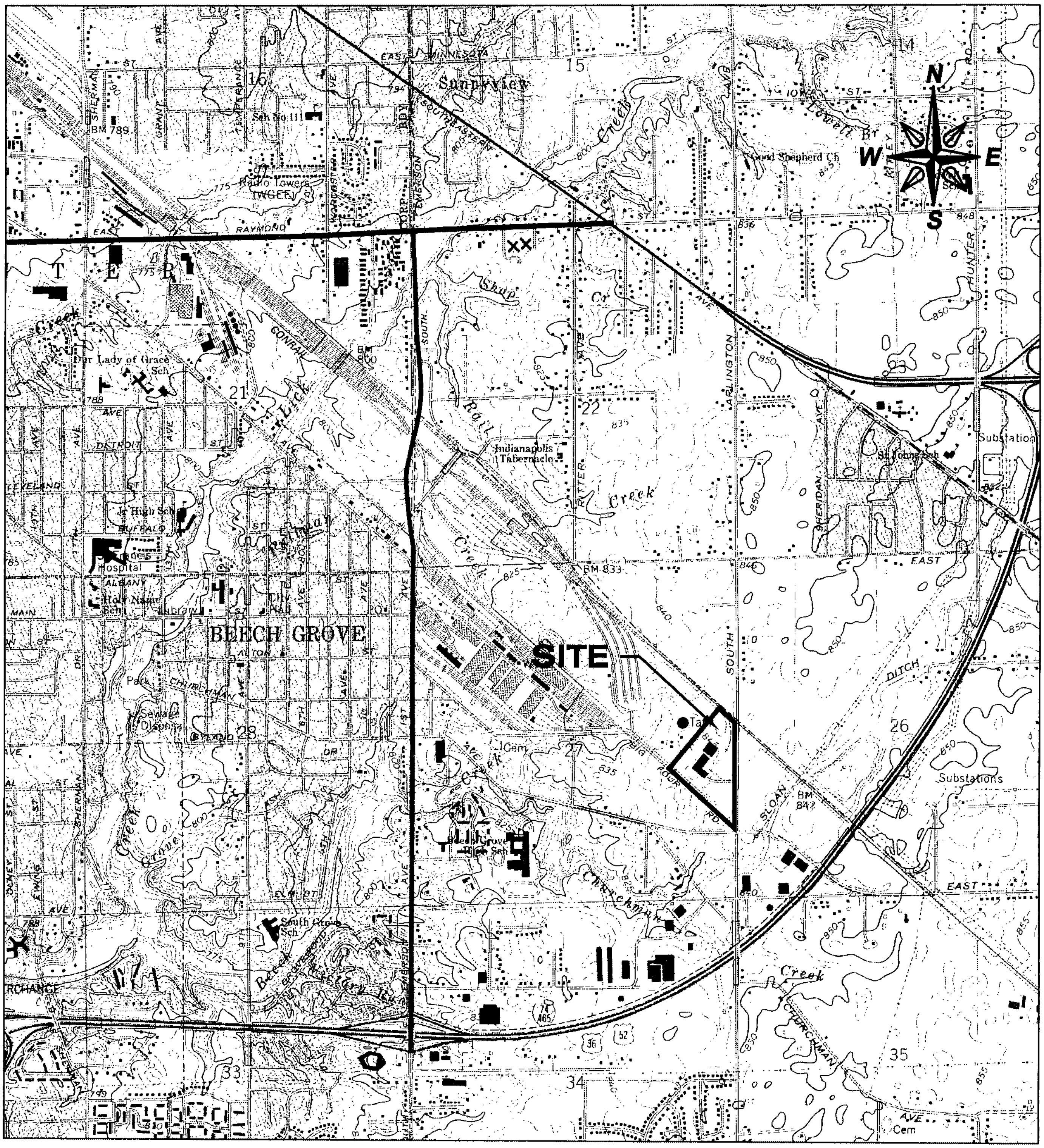
In addition to the flows through the storm water management basin, approximately fifty percent of the containment cell cap will drain into a trapezoidal swale along the west side of the cell.

The final configuration for the swale has not been designed, but it is expected to consist of a 8 or 12 inch diameter pipe discharging into the CSX drainage ditch as shown on Sheet 9.

11.0 POST CLOSURE INSPECTION AND MAINTENANCE

The post closure inspection and maintenance plan is provided as Attachment E.

FIGURES



REF. U.S.G.S. 7 1/2 MINUTE
BEECH GROVE, IND
QUADRANGLE MAP

CORRECTIVE MEASURES DESIGN
REFINED METALS CORPORATION
BEECH GROVE, INDIANA

2000 0 2000 4000

SCALE IN FEET

Scale: 1"=2000'	SITE LOCATION MAP
Originated By: K.M.S.	
Drawn By: P.S.G.	
Checked By: S.W.K.	Advanced GeoServices Corp. 1055 Andrew Drive, Suite A West Chester, Pennsylvania 19380 (610) 840-9100 FAX: (610) 840-9199
Project Mgr: P.G.S.	
Dwg No. 2003-1046-05-02	
Issued:	Project No. 2003-1046-05 — FIGURE: 1

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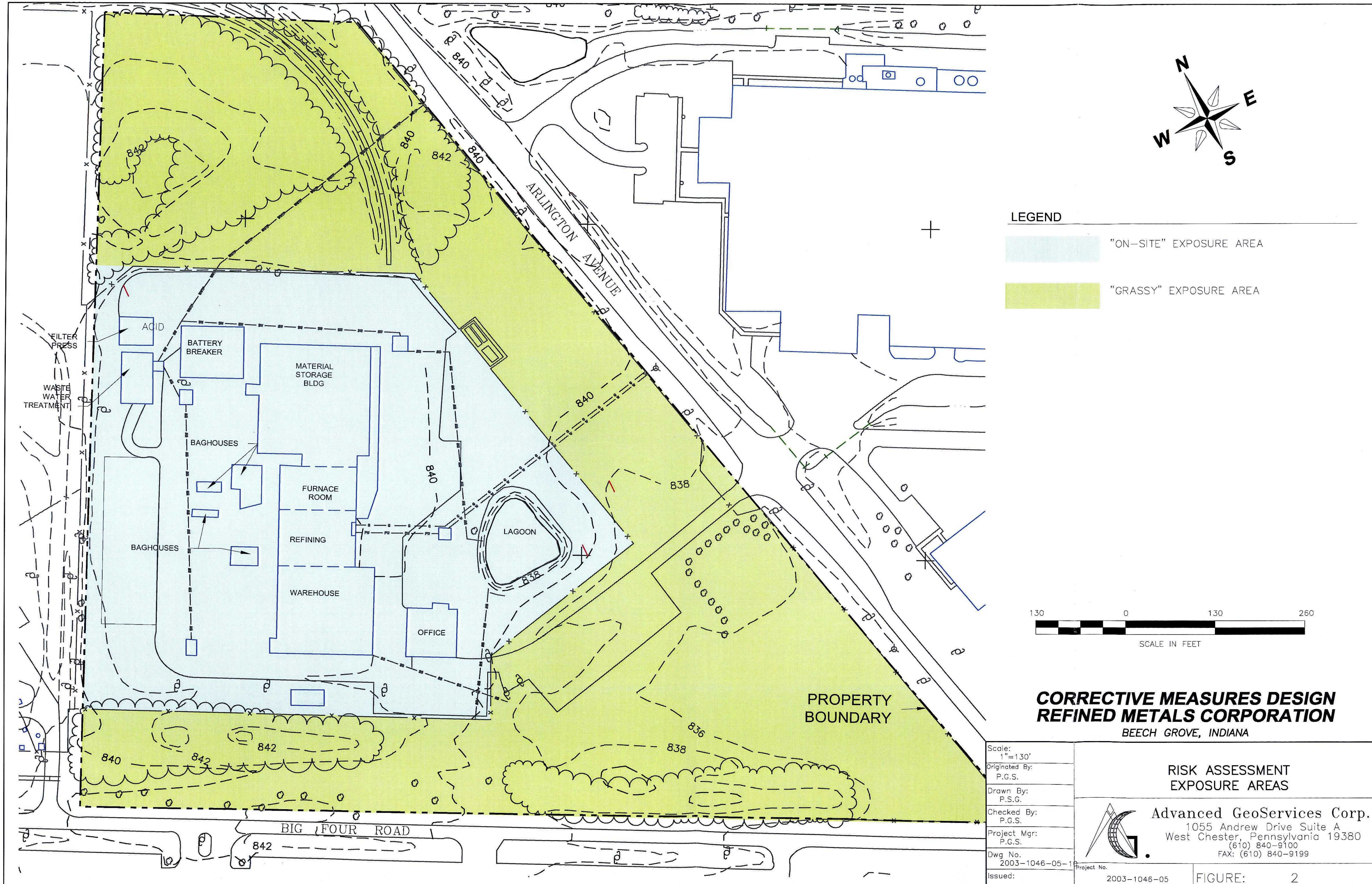

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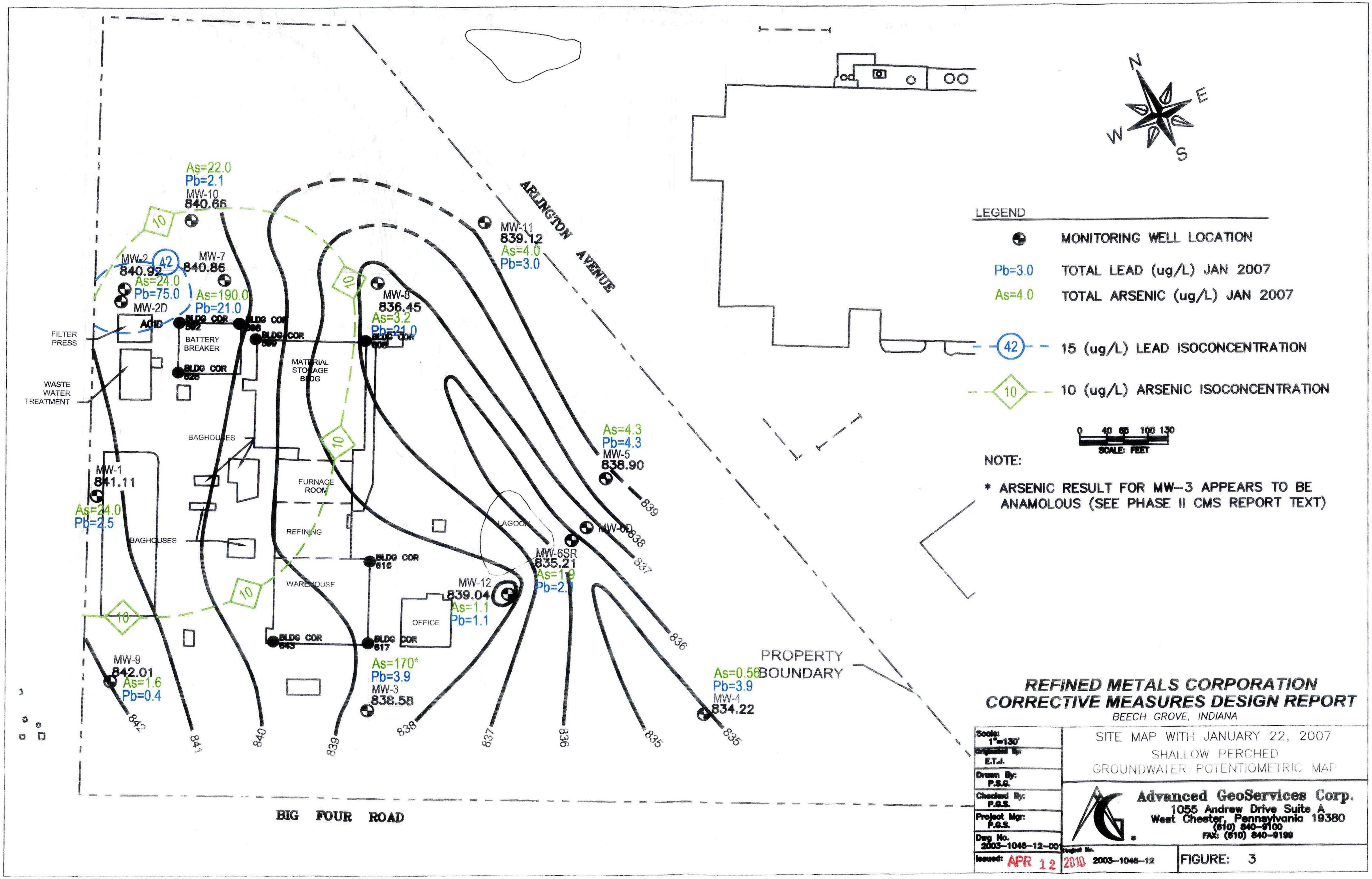

ARLINGTON AVENUE
BIG FOUR ROAD
N
E
S
W
LEGEND
MONITORING WELL LOCATION
Pb=3.0 TOTAL LEAD (ug/L) JAN 2007
As=4.0 TOTAL ARSENIC (ug/L) JAN 2007
42 15 (ug/L) LEAD ISOCONCENTRATION
10 10 (ug/L) ARSENIC ISOCONCENTRATION
0 40 65 100 130
SCALE: FEET
NOTE:
* ARSENIC RESULT FOR MW-3 APPEARS TO BE ANAMOLOUS (SEE PHASE II CMS REPORT TEXT)
As=22.0
Pb=2.1
MW-10
840.66
MW-2
840.92
As=24.0
Pb=75.0
MW-2D
MW-7
840.86
As=190.0
Pb=21.0
MW-11
839.12
As=4.0
Pb=3.0
MW-8
836.45
As=3.2
Pb=21.0
MW-1
841.11
As=24.0
Pb=2.5
As=4.3
Pb=4.3
MW-5
838.90
MW-6D
MW-6SR
835.21
As=1.9
Pb=2.1
MW-12
839.04
As=1.1
Pb=1.1
MW-9
842.01
As=1.6
Pb=0.4
As=170*
Pb=3.9
MW-3
838.58
As=0.56
Pb=3.9
MW-4
834.22
FILTER PRESS
WASTE WATER TREATMENT
ACID
BATTERY BREAKER
MATERIAL STORAGE BLDG
BAGHOUSES
FURNACE ROOM
REFINING
WAREHOUSE
OFFICE
LAGOON
BLDG COR 582
BLDG COR 586
BLDG COR 589
BLDG COR 606
BLDG COR 625
BLDG COR 616
BLDG COR 643
BLDG COR 617
PROPERTY BOUNDARY
842
841
840
839
838
837
836
835
REFINED METALS CORPORATION
CORRECTIVE MEASURES DESIGN REPORT
BEECH GROVE, INDIANA
SITE MAP WITH JANUARY 22, 2007
SHALLOW PERCHED
GROUNDWATER POTENTIOMETRIC MAP
Scale: 1"=130'
Originated By: E.T.J.
Drawn By: P.S.G.
Checked By: P.G.S.
Project Mgr: P.G.S.
Dwg No. 2003-1046-12-001
Issued: APR 12 2010
Project No. 2003-1046-12
FIGURE: 3
Advanced GeoServices Corp.
1055 Andrew Drive Suite A
West Chester, Pennsylvania 19380
(610) 840-9100
FAX: (610) 840-9199

ATTACHMENT A

Design Drawings
(Provided Separately)

ATTACHMENT B

Construction Specifications

DIVISION 1
GENERAL REQUIREMENTS

DIVISION 2
SITE WORK

SPECIFICATIONS

DIVISION 1

SECTION 01010

SUMMARY OF WORK

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

The Work to be performed under these Specifications represents the proposed Corrective Measures to be completed by Refined Metals Corporation (RMC) to address elevated concentrations of lead and associated inorganic compounds in soil, sediment and groundwater identified on and around the RMC facility in Beech Grove, Marion County, Indiana. Major components of the Work include the following:

A. Installation and maintenance of erosion and sediment control measures, storm water management controls, temporary access controls, and decontamination facilities associated with the proposed work.

B. Clearing, grubbing and disposal of brush and trees from within areas of proposed remediation and containment cell construction.

C. Construction of a containment cell for consolidation of excavated soil, “sediment”, and designated debris.

D. Excavation of on-site soil exceeding 970 mg/kg total lead, 37 mg/kg antimony, 20 mg/kg arsenic, 77 mg/kg cadmium and 53 mg/kg selenium within HWMU areas, as shown on the Hazardous Waste Management Unit Closure Plan (Sheet 6).

E. Closure of the on-site surface impoundment (lagoon) and demolition of its concrete liner component following removal of liquid, bulk sediment, vegetation, liner material and miscellaneous debris.

F. Excavation of on-site soil from areas outside the HWMUs exceeding 4,954 mg/kg total lead in “grassy” exposure areas and 8,470 mg/kg total lead in paved exposure areas, as shown on Soil and Sediment Excavation Plan East (Sheet 7).

G. Excavation of soil and “sediment” exceeding 400 mg/kg total lead in off-site areas, as shown on Soil and Sediment Excavation Plans East and West (Sheets 7 and 8).

H. Handling, loading, transporting and placement of excavated materials in the containment cell.

I. Identification of borrow sources for; and procurement of topsoil, structural soil fill, and cover soil fill meeting the requirements of these Specifications.

J. Restoration of those areas of the site disturbed as a result, directly or indirectly, of the soil excavation activities and associated work.

K. Mobilization and operation of a temporary water treatment system for accumulated stormwater and groundwater from disturbed site areas and decontamination water.

L. Operation of existing storm water management system (pumps and piping) from the time of mobilization through site stabilization and initiation of gravity storm water drainage through proposed discharge features.

M. Establish stormwater drainage and management system capable of capturing, controlling and discharging stormwater runoff without the use of pumps.

1.2 RELATED SECTIONS

A. Corrective Measures Design (including all Attachments)

B. All Sections of these Specifications

1.3 CONTRACTOR RESPONSIBILITIES

A. Furnish all materials, tools, equipment, supervision, administration and transportation, and perform all labor and services necessary to furnish, deliver, construct, install, and/or complete all Work described in the Contract.

B. As necessary for proper execution and completion of work and as applicable, secure and pay for required permits, licenses, health and safety training, and medical monitoring for it's own employees working at the site.

C. Provide at least 2 weeks advanced notification of commencement of mobilization.

D. Locate and protect existing utilities prior to working in or adjacent to areas containing existing utilities pursuant to the requirements of the Indiana One-Call system and through the use of a private utility locator.

E. Until final acceptance of the Work by RMC, the Contractor shall have the charge and care thereof and shall take every reasonable precaution against injury or damage to the completed work. The Contractor shall repair, restore, and make good, to the satisfaction of RMC all damages to any portion of the work before final acceptance and shall bear the expense thereof.

F. Contractor shall provide experienced, competent and trained personnel to perform the Work. Contractor shall provide, at a minimum, a project superintendent familiar with all details of the project, adept at the designated position and capable of communicating with Contractor personnel, and representatives of RMC, USEPA, and IDEM.

G. Contractor shall be responsible for providing barriers, safety guards, signage and temporary fencing as required by the owners of the properties where work is being performed, and as required by appropriate safety regulations.

1.4 CONTRACTOR USE OF WORKSITE

A. General

1. The Contractor shall confine operations at the site to areas indicated on the design drawings and shall not unreasonably encumber the site with any materials or equipment.

2. The Contractor shall limit their work on properties not owned by RMC to between the hours of 7:00 a.m. and 6:00 p.m., Monday through Friday, except legal holidays. Work on RMC property shall be limited to 6:00 a.m. to 7:00 p.m., Monday through Friday and Saturday 7:00 a.m. to 5:00 p.m., unless otherwise restricted by local ordinance. Additional working hours, or work on Sundays will only be permitted with prior approval by RMC.

3. Keep existing driveways and entrances serving the site clear and available at all times.

4. Consider the safety of the Work, and that of people and property on and adjacent to worksite, when determining amount, location, movement, installation, and use of materials and equipment on worksite. Work zone safety fencing shall be used to demark active work zones outside the site security. Within the site security fence the Contractor shall provide

protection around work zones in accordance with applicable regulatory statutes and as necessary to prevent uncontrolled access.

5. Site security shall be the Contractor's responsibility. RMC will maintain part-time dusk to dawn security service that consist of an unarmed guard visiting the site at irregular intervals during the night. RMC is not responsible for security of Contractor's equipment and materials.0

6. Protect the general public from construction-related activities, conduct work in a manner, which will ensure that pedestrian and vehicular traffic will either not be obstructed or obstructed to the least possible degree.

7. Work on non-RMC property will be subject to limits and restrictions imposed by property owner.

1.5 EXISTING CONDITIONS

A. The existing conditions represented on the design drawings are based on the best available information obtained from one or any combination of the following sources: field survey, aerial photographs, reference drawings, or visual investigation. The Contractor shall retain an Indiana Licensed Professional Surveyor to document starting conditions and establish vertical and horizontal controls for the project.

B. If conditions are significantly different to those presented on the design drawings such that they could effect the schedule, cost or execution of the work, the Contractor shall submit a detailed description of the conditions observed within two work days of their identification.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SECTION 01050

FIELD ENGINEERING

PART 1: GENERAL

1.1 DESCRIPTION

A. Work included: This Section of the Specifications covers field engineering services required for proper completion of the Work including, but not limited to:

1. Establishing and maintaining lines and levels, including field locating the property north and west of the proposed Containment Cell.

2. Surveying pre-removal conditions (topography and physical features) within the limits of contaminated soils and sediment designated for removal, and establishing reproducible grids or cross-sections for controlling removal depths.

3. Documenting final removal limits using the grids and cross-sections described above.

4. Providing As-Built Drawings of restored site conditions as part of the final project closeout. As-Built Drawings shall also document the finished surface of the materials placed in the Containment Cell and top of the finished cap.

5. Structural design of shores, forms, and similar items provided by the Contractor (if any) as part of the means and methods of construction.

6. The Contractor will retain the services of an Indiana Licensed Professional Surveyor to perform pre-removal and as-built surveys. The Contractor may utilize his own equipment and personnel to provide grade control during excavation activities and document final removal limits, provided the techniques and equipment are acceptable to the QA Representative and tied into the vertical and horizontal controls established by the surveyor.

1.2 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 02110 - Site Clearing and Grubbing

C. Section 02115 - Erosion and Sediment Control Measures

D. Section 02209 - Excavation/Handling/Placement

E. Section 02210 - Earthwork

F. Section 02831 – Security Fencing

1.3 DEFINITIONS

A. As-Built Drawings – Drawings at a similar scale and level of detail as the design drawings showing an accurate record of all deviations from the approved design drawings and Specifications which may occur in the Work as actually constructed. The Contractor will be provided with electronic copies of the design drawings for use in development of the As-Built Drawings. As-Built Drawings shall be signed and sealed by the Contractor's surveyor.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. A land surveyor licensed to practice in the State of Indiana shall be directly responsible for survey work performed by the Contractor.

C. RMC will retain the services of a full-time Quality Assurance (QA) Representative to observe and document progression of the work and collect required post-excavation samples and perform other activities specifically designated in the Construction Quality Assurance Plan (CQAP) and Specifications.

D. The Contractor will be responsible for providing appropriately qualified personnel to perform Quality Control (QC) testing throughout the project, including performing air monitoring, compaction testing, liner installation and material testing.

1.5 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.

B. The Contractor shall provide, at a minimum, As-Built Drawings, signed and sealed by the Contractor's Surveyor, for the following components:

1. The initial excavation/removal work areas documenting original conditions.

2. Areas of clearing and grubbing and demolition quantities.

3. The final elevations of the site and off-site work zones and limits of each type of restoration (i.e., seeded vegetation, sod, and crushed stone/concrete).

4. All the reasonable items requested by RMC to verify that the Work meets the requirements of the Contract.

The Contractor shall submit As-Built documentation for review by the RMC, with the request for final payment or at the completion of the applicable phases of the work.

C. The Contractor shall prepare a Daily Report detailing any and all work and health and safety activities that were performed. The Daily Report shall be prepared by noon the following work day and a copy submitted to the QA Representative. Results of Quality Control sampling and testing shall be provided as attachments to the Daily Report.

D. Contractor shall prepare and submit a Construction Schedule presenting the planned sequence for execution of the work. The Construction Schedule shall identify the sequence of excavation activities on a removal area by removal area basis, planned start and end dates for each major tasks, and other relevant information required for control of the work. The schedule shall be updated at least every two weeks to show actual versus planned progress and reflect changes in the schedule.

PART 2: MATERIALS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1: GENERAL

1.1 DESCRIPTION

A. This Section of the Specifications covers all submittals including material specifications and manufacturer's data; proposed subcontractors qualifications and insurance information, panel placement plan for geomembrane installation, sequence of construction information, schedule, and borrow source testing information. Contractor shall make submittals utilizing a standardized transmittal form acceptable to the QA Representative.

B. Upon award of the Contract, but no later than fourteen (14) calendar days before mobilization the Contractor shall prepare a submittal register for review and approval by the QA Representative.

1.2 RELATED SECTIONS

A. The appropriate Sections of Division 1 and Division 2 of these Specifications.

1.3 SUBMITTAL REGISTER

A. The submittal register shall be submitted no later than fourteen (14) calendar days before mobilization. The submittal register shall include all submittal items listed in the Specifications and shall also provide the following information, at a minimum:

1. Project name;
2. Contractor's project or reference number;
3. Submittal title and description of item and Specification section;
4. Submittal reference number sequentially numbered; and
5. Columns for submittal date, response date and approval status.

B. The submittal register shall include blank rows for future addition of submittals that were not anticipated. Upon inclusion of additional line items in the submittal register, the Contractor shall resubmit an updated submittal register for use by RMC and the Engineer.

1.4 SUBMITTAL SCHEDULE

A. The Contractor is required to make submittals sufficiently in advance of delivery of associated materials or commencement of associated work to allow review and response by the QA Representative. While the QA Representative will strive to turnaround submittals as quickly as possible, the Contractor should anticipate that submittals will require 5 days for review and response. Submittals that are considered incomplete or item unacceptable will be returned and will require resubmission.

1.5 SUBMITTALS

A. The minimal information required for each submittal is found in its respective Section of these Specifications. The following is a partial list of submittals related to the project:

1. Construction Schedule and Narrative Sequence of Construction
2. Contractor's Health and Safety Plan
3. Subcontractor's Qualifications and Insurance Information
4. Temporary Water Treatment System Information
5. Geotechnical and Analytical Data for Proposed Borrow Sources
6. Manufacturers Specifications and Cut-Sheets for Materials
7. Geomembrane Installer's Panel Placement Plan
8. As-Built Drawings

B. A submittal cover sheet or transmittal sheet shall accompany each submittal and shall include all information specified in these Specifications. The transmittal sheets shall be sequentially numbered and shall be of the same format for all submittals.

C. Submittals will be reviewed by the QA Representative. Where appropriate, the QA Representative will solicit input from RMC or the Engineer regarding the adequacy/acceptability of the proposed item.

D. The Contractor shall apply a stamp or signature certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the Contract Documents.

E. The results of review of submittals will be used as follows:

1. NO EXCEPTIONS TAKEN;
2. PROCEED AS NOTED; REVISE AND RESUBMIT FOR RECORD;
3. DO NOT PROCEED; REVISE AND RESUBMIT;
4. REJECTED; or,
5. NOT APPLICABLE.

F. Submittals not in compliance with the Specifications will be returned to the Contractor for revision. Any loss of time and additional costs associated with resubmittal(s) are the Contractor's responsibility.

G. Submittals that are "Proceed as Noted" are for the purpose of expediting procurement of the intended work. The Contractor shall incorporate all corrections and resubmit revised submittal to QA Representative within seven (7) calendar days of the "Proceed as Noted" action. Payment for completed work that is related to the "Proceed as Noted" submittal will not be made until the corrected and final resubmittal is accepted in writing by the QA Representative.

1.6 SUBSTITUTIONS

A. "Or Equals" Substitutions

1. Equals Considered - Whenever a material or article required is specified or shown on the plans by using the name of the proprietary product or of a particular manufacturer or vendor, any material or article which will perform adequately the duties imposed by the general design, will be considered equal and satisfactory provided the material or article so proposed is of equal properties and function in the opinion of QA Representative.

2. The Contractor shall document each request with complete data substantiating compliance of the proposed Substitution with the Contract Documents. "Or Equal" requests will be considered only when substantiated by the Contractor's submittal of data documenting the "Or Equal" nature of material or article. A request constitutes a representation that the Contractor:

   a. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.

   b. Shall provide the same warranty for the substitution as for the specified product.

   c. Shall coordinate installation and make changes to other work, which may be required for the Work to be complete with no additional cost to RMC.

   d. Shall waive claims for additional costs or time extension, which may subsequently become apparent.

   e. Shall reimburse RMC for review or redesign services associated with review and approval.

   d. Shall waive claims for additional costs or time extension, which may subsequently become apparent.

3. The Contractor shall provide substitutions in a timely manner and in accordance with the CMD and the Contract with RMC, so as to not have a negative impact on the Construction Schedule.

1.7 PRODUCT DATA

A. Collect product data into a single submittal for each element of fabrication or system. Product data includes printed information such as manufacturer's installation instructions, catalog costs, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves.

B. Mark each copy to show applicable choices and options. Where product data includes information on several products, some of which are not required, mark copies to indicate the applicable information.

C. Do not submit product data until compliance with requirements of the Contract Documents has been confirmed.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

3.1 IDENTIFICATION OF SUBMITTALS

A. The Contractor shall consecutively number all submittals.

1. When resubmittal(s) is made for any reason, the Contractor shall transmit under a new letter of transmittal with a new transmittal number.

2. On resubmittals, the Contractor shall cite the prior transmittal number(s).

B. The Contractor shall maintain an accurate submittal log for the duration of the Work, showing current status of all submittals at all times. The Contractor shall make the submittal log available for review upon request.

3.2 GROUPING OF SUBMITTALS

A. Unless otherwise specified, the Contractor shall make submittals in groups containing all associated items to assure that information is available for checking of each item when it is received.

B. Partial and poorly prepared submittals will be rejected as not complying with the requirements of the Contract. The Contractor will be liable for related delays.

3.3 TIMING OF SUBMITTALS

A. In scheduling, the Contractor shall allow five (5) calendar days for review and processing by the QA Representative following its receipt of the submittal.

This review time will be increased for the submittal(s) that are so extensive that the five (5) calendar day turn around period is unreasonable, as determined by the QA Representative.

C. It is understood that work affected by the submittal may progress only after the QA Representative has returned the approved, signed and stamped transmittal cover sheet to the Contractor. The Contractor will be responsible for the repair, modification or removal of completed work, which had not been approved.

3.4 QA REPRESENTATIVE'S REVIEW

A. Review and Processing shall not relieve the Contractor from responsibility for errors, which may exist in the submitted data.

B. Revisions:

1. The Contractor shall make required revisions as noted on initial submittal.

2. If the Contractor considers any required revision to be a change, it shall so notify RMC in writing within 3 calendar days.

END OF SECTION

SECTION 01351

HEALTH AND SAFETY PLAN REQUIREMENTS

PART 1: GENERAL

1.1 DESCRIPTION

A. The Work of the Contract covered by this section shall include the development and implementation of a Health and Safety Plan (HASP) for all proposed Corrective Measures activities contemplated as part of the proposed Work. The Contractor shall provide all expertise, supervision, labor, materials, and equipment necessary to develop, prepare, and implement the Health and Safety Plan as detailed in this Section and as accepted by USEPA, IDEM and RMC.

B. The Contractor shall develop and implement all necessary precautions for the safety of, and provide the necessary protection to prevent damage, injury or loss to:

- All employees and subcontractors participating in performance of the Work.
- All components of the Work, any materials to be used or incorporated in the Work, and any equipment to be employed in the execution of the Work, whether on- or off-site.
- Other property on or adjacent to the project site including trees, shrubs, lawns, fences, sidewalks, pavements, roadways, structures and utilities not designated for removal, relocation, or replacement in the course of construction.
- Adjacent property of owners/landowners and residents.

1.2 RELATED SECTIONS

A. All of the CM Design (including all attachments).

B. United States Federal Government - Code of Federal Regulations (CFR)

1. 29 CFR 1910 – Occupational Safety and Health Standards

2. 29 CFR 1910.120 - Hazardous Waste Operations and Emergency Response

3. 29 CFR 1910.134 - Respiratory Protection

4. 29 CFR 1910.1200 - Hazard Communication

5. 29 CFR 1926 - Construction Standards

6. 29 CFR 1910.1025 – Lead in Construction

1.3 QUALITY ASSURANCE

A. The Contractor's draft Health and Safety Plan (HASP) will be reviewed for content by the USEPA, IDEM and RMC. Each will return comments within one week from receipt of the draft HASP.

B. The Contractor shall carefully review and consider all elements of the Work of the Contract during preparation of the HASP and verify that all elements of the Contract Documents are thoroughly addressed. Incomplete or missing elements in the HASP will create delays in approval which will delay the commencement of Work.

1.4 GENERAL PLAN REQUIREMENTS

A. The Contractor shall develop a written site-specific HASP which complies with applicable regulations under the Code of Federal Regulations prior to commencing any on-site work and continue to implement, maintain, and enforce the HASP until final demobilization from the site.

B. The health and safety guidelines contained herein are intended to provide for a safe and minimal risk working environment for on-site personnel and to minimize the impact of activities involving contact with excavated soils on the general public and the surrounding environment.

C. The Contractor shall be responsible for the safety of persons and property on the site and for the protection of persons off the site and the environment to the extent that it may be affected by the conduct of the Work. The Contractor shall comply with and enforce compliance by employees of the Contractor and subcontractors with safety requirements of the CMD, laws and regulations, and HASP.

D. Hazard Communication Requirements

1. The Contractor shall comply with the requirements of OSHA's Hazard Communication rule, 29 CFR 1910.1200, obtaining information on any hazardous chemical or harmful physical agent to which personnel of the Contractor and subcontractors, and visitors have potential exposure during the Work.

2. The Contractor shall include Material Safety Data Sheet (MSDS) documentation on any hazardous chemicals that the Contractor and/or its subcontractor's plan to utilize for the Work. In addition, the Contractor shall be responsible for meeting container warning label requirements in accordance with OSHA.

E. Work Stoppage: The Contractor shall give precedence to the safety and health of the public and on-site personnel and the protection of the environment for all Work. The Contractor's designated health and safety officer shall be responsible for decisions regarding when the Work will be stopped and re-started for health or safety considerations. The Contractor shall be responsible for all costs and delays at no extra cost to RMC.

F. Unforeseen Hazards: Should any unforeseen or site-specific safety-related factor, hazard, or condition become evident during performance of the Work at the Site, the Contractor shall bring such to the attention of RMC verbally and in writing as quickly as possible, for resolution. In the interim, the Contractor shall take prudent action to establish and maintain safe working conditions and to safeguard employees of Contractor and its subcontractors, the public, the property owner, RMC and its representatives, and regulators.

1.5 BASIS OF PROGRAM

A. OSHA standards and regulations contained in 29 CFR 1910 and 1926 provide the basis for the health and safety program. The program also reflects the position of USEPA and NIOSH regarding procedures recommended or required to ensure safe operations at sites containing hazardous or toxic materials.

1.6 SITE CHARACTERIZATION

A. Based on past sampling activities, work at the site will involve contact with materials containing lead, arsenic and other metals. Results of soil and sediment sampling are provided in the design drawings.

1.7 SUBMITTALS

A. The Contractor shall submit the draft Health and Safety Plan (HASP) in electronic format to RMC for review and comment at least two weeks prior to the start of work. The Contractor's HASP shall include; but is not limited to, required drawings, figures, tables, forms, resumes and appendices.

B. The Contractor shall not proceed with the Work until RMC, the USEPA and IDEM have accepted the Contractor's HASP.

C. The Contractor's HASP shall be a stand alone document that correlates health and safety procedures to each work element in a clear and concise manner.

D. Health and Safety Plan shall include the following:

1. Site control measures in accordance with 29 CFR 1910.120 (d) and 29 CFR 1926.65 (d).

2. A safety and health risk or hazard analysis for each site task and operation, including measures or controls for each task/operation.

3. Personnel training assignments in accordance with 29 CFR 1910.120 (e) and 29 CFR 1926.65 (e), 29 CFR 1910.1001 (j), and 29 CFR 1910.1025 (l).

4. Personal protective equipment to be used by personnel for each site task and operation being conducted in accordance with 29 CFR 1910.1209 (g)(5) and 29 CFR 1926.65 (G)(5).

5. Medical surveillance requirements in accordance with 29 CFR 1910.120 (f) and 29 CFR 1926.65 (f).

6. Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

7. Decontamination procedures in accordance with 29 CFR 1910.120 (k) and 29 CFR 1926.65 (k).

8. A written respiratory protection program for project activities.

9. Procedure for dealing with heat and/or cold stress.

E Air Monitoring Reporting: Submit daily, on a separate Contractor designated form, air monitoring results.

PART 2: PRODUCTS AND PERSONNEL

2.1 DESIGNATED HEALTH AND SAFETY OFFICER

A. Employ and assign to the Work a competent and authorized representative herein referred to as the Health and Safety Officer. Health and Safety Officer Qualifications:

1. Site-related working experience specific to the activities associated with soil remediation projects.

2. Have a basic working knowledge of state and federal occupational safety and health regulations.

3. Have formal education and/or training in occupational safety and health.

B. Health and Safety Officer Responsibilities:

1. Obligated to stop or start the work when it is necessary or advisable for reasons of health or safety.

2. Completing daily health and safety training sessions (i.e. "tailgate meetings").

3. Implementing and daily enforcement and monitoring of the site-specific HASP.

4. Be on the site during the execution of Work at the site.

2.2 PERSONNEL HEALTH, SAFETY, AND HYGIENE

A. Medical Surveillance: Conduct medical surveillance of personnel as required by 29 CFR 1910.120, 29 CFR 1926.65, and 29 CFR 1910.134.

B. Training: Furnish personnel assigned to or entering the site who have successfully completed training required by the applicable OSHA Standards in 29 CFR 1910 and 29 CFR 1926 and specifically with 29 CFR 1910.120 and 1926.65.

C. Levels of Protection: Establish actual levels of protection for each task based on planned activity and location of activity.

D. Personal Protective Equipment (PPE):

1. Furnish on-site Contractor personnel with appropriate PPE. Clean and maintain safety equipment and protective clothing. As a minimum, each worker on-site shall wear a hard hat, safety glasses with side shields, safety boots with steel toes and shank, and full-length pants.

2. Develop protective equipment usage procedures and enforce strict compliance with such procedures by on-site personnel.

E. Respiratory Protection

1. Furnish on-site personnel with training in the usage and limitations of, and qualitative fit testing for, air purifying and supplied-air respirators in accordance with 29 CFR 1910.134.
2. Develop, implement, and maintain a written respiratory program in accordance with 29 CFR 1910.134.

3. Monitor, evaluate, and provide respiratory protection for on-site personnel, as appropriate.

4. Immediately notify RMC if level of respiratory protection required increases from Level D to Level C.

F. Heat Stress/Cold Stress: Implement a heat stress and/or cold stress monitoring program as applicable and include in the site-specific Health and Safety Plan.

G. Personnel Hygiene and Personnel Decontamination Procedures.

1. Provide, as a minimum, the following:

a. Suitable containers for storage and disposal of used disposable PPE.

b. Potable water and a suitable sanitation facility.

H. Emergency and First-Aid Equipment

1. Locate and maintain emergency and first-aid equipment in appropriate location on the site, including:

a. First-Aid kit to accommodate the number of on-site personnel.

b. ABC type dry chemical fire extinguishers.

2. As a minimum, provide one (1) certified first-aid technician on the site at all times when on-site work activities are in progress. This technician may perform other duties but shall be immediately available to render first aid when needed.

I. Site Communications:

1. Post emergency numbers near the site telephones.

2. Furnish selected personnel with 2-way radios.

J. Safety Meetings: Conduct mandatory daily safety meetings for on-site personnel, and additionally as required by special or work-related conditions; include refresher training for existing equipment and protocols, review ongoing safety issues and protocols, and examine new site conditions as they are encountered. Hold additional safety meetings on an as-needed basis.

K. The Contractor shall be responsible for keeping safety equipment and facilities clean, properly equipped, and maintained. The Health and Safety Officer shall perform other duties for Contractor but the first priority shall be maintenance of protective equipment and the personnel decontamination area.

2.3 AIR MONITORING

A. The Contractor shall develop an air monitoring program meeting the requirements of 29 CFR 1910.120 (h) and 29 CFR 1926.65 (h).

B. The Contractor shall monitor the progress of work activities, monitor air quality in and around the exclusion zone. The Contractor shall conduct all required air monitoring.

C. The Contractor shall provide the required instruments for air monitoring including, but not limited to, as a minimum:

1. Dust monitor (mini Ram or equivalent).
2. High-Volume Air Monitors

D. The Contractor shall operate air monitoring equipment with personnel trained in the use of the specific equipment provided under direct control of the Contractor's health and safety officer.

E. The Contractor shall conduct all required air monitoring during the Work of the Contract.

2.4 SITE CONTROL

A. The Contractor shall comply with 29 CFR 1910.120 (d) and 20 CFR 1926.65 (d).

B. The Contractor shall provide in the HASP a figure or map which presents the delineation of the work zones for Project activities considered in the Work of the Contract.

C. The Contractor shall provide in the HASP a discussion on Site security issues.

D. The Contractor shall provide in the HASP a detailed discussion on decontamination procedures for both equipment and personnel, including collection and disposal of wash waters and spent PPE.

PART 3: EXECUTION

3.1 HEALTH AND SAFETY PLAN

A. The Contractor shall prepare a written Health and Safety Plan which is applicable to all components of the Work. The HASP shall be based upon the requirements and guidelines described herein and all provisions of applicable law. The Contractor's HASP will apply to all personnel on-site including the Contractor and its subcontractors, RMC and its representatives, the property owners, the USEPA, the IDEM and other regulatory agencies. The Contractor shall include additional information as appropriate and may utilize any format provided it is neat, clean and complete.

B. The Contractor shall ensure that the HASP meets, at a minimum, the requirements of OSHA Standards and Regulations contained in Title 29, Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 1926).

C. In addition, the Contractor's HASP must include at a minimum, the following information:

- Responsibilities of the Contractor and its Health and Safety Officer and the name of the Health and Safety Officer and assistant health and safety personnel to be utilized on site.

- A description of the Work to be performed at the Site and how health and safety activities are related to the work.

- A hazard evaluation, including discussions of potential hazards involved with the Work.

- A discussion of proposed environmental and personnel monitoring including specific types of equipment to be used and action levels to be instituted.

- Personnel protection requirements for specific work areas, specific activities or specific tasks. The Contractor shall supply all personal protective equipment.

- Personnel and equipment decontamination procedures.

- Training requirements for personnel utilizing personal protective equipment. The Contractor shall provide 40 hours of classroom training supplemented with site-specific training as required by OSHA in 29 CFR 1910.120 for all personnel who will be working on-site prior to their initiating on-site work. Additionally, the Contractor's supervisory personnel shall receive an additional 8 hours of supervisory training.

- Daily and weekly safety logs and a closeout safety report to be prepared by the Contractor.

3.2 IMPLEMENTATION OF PLAN

A. Once the Health and Safety Plan (HASP) has been accepted by RMC, the USEPA and the IDEM, then the requirements of the HASP shall be enforced and the Contractor shall commence the remediation activities.

B. The Contractor shall provide an on-site Health and Safety Officer during all Work activities, appropriately trained and certified for supervisory responsibility in health and safety protection. An alternate Health and Safety Officer, with appropriate training, must be designated to serve when the Health and Safety Officer is not on-site.

C. It shall be the responsibility of the Contractor's Health and Safety Officer to ensure that all health and safety requirements are implemented per the approved HASP.

D The Contractor's Health and Safety Officer shall be responsible for personnel decontamination and emergency response measures.

E. The Contractor's Health and Safety Officer shall have the authority to act on all health and safety issues and matters, and to establish new controls, procedures or facilities as needed.

END OF SECTION

SECTION 01355

WASTE MANAGEMENT AND DISPOSAL PLAN REQUIREMENTS

PART 1: GENERAL

1.1 DESCRIPTION

The proposed Work is not expected to generate a significant volume of waste materials requiring offsite disposal or recycling. The only anticipated waste materials requiring off-site management will be minor amounts of scrap metal destined for recycling, general refuse generated by the temporary office facilities and materials generated during the clearing and grubbing process.

1.2 RELATED SECTIONS

A. Section 01300 - Submittals

B. Section 01351 - Health and Safety Plan Requirements

C. Section 02110 – Clearing and Grubbing

D. Section 02150 – Demolition of Remnant Structures

E. Section 02209 - Excavation/Handling/Placement

1.3 SUBMITTALS

The Contractor shall submit for RMC approval all proposed disposal or recycling facilities. Submittal shall include copies of current operating permits and proof of insurance for the facility and the name and contact information of the IDEM facility inspector.

PART 2: PRODUCTS

2.1 WASTE STORAGE AND SHIPPING CONTAINERS

A. The Contractor's containers utilized to store and transport the various waste materials shall be appropriately sized and compatible with the material being managed and approved for the intended use by the Department of Transportation.

PART 3: EXECUTION

3.1 GENERAL

A. Soil, sediment and miscellaneous debris generated during the remedial activities will be placed in the Containment Cell in accordance with the procedures contained in Specification Section 02209.

B. Only materials approved by the QA Representative will be released for off-site management.

C. The proposed corrective measures will require the removal of more than 2,000 cy of concrete pavement, floor slabs and wall (excluding the MSB floor). It is the intent of RMC as part of its "Green Remediation" efforts to segregate, crush and reuse the concrete. Specific information to the procedures related to the segregation, crushing and recycling are provided in Section 02150. If concrete can not be recycled because it fails analytical requirements established in the Specifications for re-use it shall be disposed in the Containment Cell.

D. The Contractor's submittals for proposed off-site recycling or disposal facilities shall include:

1. Characterization sampling required by each facility for each type of waste and the name and qualifications of the laboratory to provide the required analysis.

2. Waste management requirements for each waste stream including labeling, manifests and bills of lading, and record keeping.

3. Name, address, telephone number, contact name, copy of operating permits and proof of insurance for each proposed disposal facility.

4. Names, address, telephone numbers, contact name, copy of operating permits and proof of insurance for each proposed transporter.

5. Description of transportation operations for each waste material.

3.2 PREVIOUSLY UTILIZED DISPOSAL AND RECYCLING FACILITIES

During the decontamination and demolition activities, the following facilities were utilized:

1. Metals Recycling – OmniSource
2. Non-Hazardous Solid Waste – Southside Landfill Inc.
3. Hazardous Solid Waste – Heritage Environmental Services

The Contractor is encouraged to utilize these same facilities for the Corrective Measures work.

END OF SECTION

SECTION 01400

QUALITY ASSURANCE/QUALITY CONTROL

PART 1: GENERAL

1.1 DESCRIPTION

A. Work Included:

The Contractor shall establish and maintain a project specific Quality Control (QC) and management program (collectively QC program) for each component to be furnished and installed under the Contract Documents. Contractor shall have the "primary" responsibility for the quality of all its work and ensure that all materials meet the requirements established in these Specifications.

B. RMC will provide a full-time Quality Assurance Representative (QA Representative) to observe and document work activities and the Contractor's QC program. The Contractor shall be responsible for the implementation QC requirements of the Corrective Measures Design. The Contractor shall not rely on RMC's QA Representative to satisfy the requirements of these Specifications, except as it relates to the collection and analysis of post-excavation samples, which will be performed by the QA Representative.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01050 - Field Engineering

C. Section 02209 – Excavation/Handling/Placement

D. Section 01300 – Submittals

E. Section 02210 – Earthwork

F. Section 02751 – Cap Drainage Layer

G. Section 02755 – Cap Barrier Layer

H. Section 02936 - Restoration

1.3 DEFINITIONS

The following definitions pertain to requirements of this Section.

A. Quality Assurance (QA):

Quality Assurance is a planned and systematic pattern of activities (for example, approved surveillance and audit requirements) designed to assure and document that the Quality Control (QC) of items or procedures are being performed in accordance with the approved remedial design and that the product of the construction will perform satisfactory in service and will meet the highest quality standards. This Section also provides a methodology for resolving problems which may occur during construction. The Construction Quality Assurance Plan (CQAP) outlines the procedures and requirements for QA.

B. Quality Control (QC):

Quality Control is defined as those actions taken by manufacturers, fabricators, installers and contractors that provide a means (for example, through examining, witnessing, inspecting, checking and testing of in-process or completed work) to measure performance and to demonstrate that the characteristics of an item or service meet the contractual and regulatory requirements, as well as to document the results. Specific QC procedures and requirements are outlined in these Specifications. The Contractor performs Quality Control.

1.4 SUBMITTALS

A. The Contractor shall submit the names and qualifications of the personnel retained by the Contractor to conduct Quality Control activities. At a minimum this is expected to include geotechnical engineering testing services (i.e. compaction testing) and geomembrane installation quality control. If the geomembrane installation QC is conducted by the liner installer, the qualification of the installers QC representative shall be submitted with the liner installer company's qualifications.

1.5 SITE QUALITY CONTROL

A. The Contractor shall identify an individual within its organization at the site of the Work, who shall be responsible for overall management of Quality Control.

B. Material arriving at the site shall be inspected and documented to conform to the Contract requirements. Nonconforming and damaged material shall be segregated and removed from the site.

C. The Contractor shall protect all materials and equipment from rust, corrosion and similar damage.

D. The Contractor shall, as soon as the material arrives at site (but before beginning installation), provide to RMC the original bill of lading and required certifications stating that the material complies with the requirements of the Contract Documents.

E. The Contractor shall perform necessary and specified tests as received and shall document the results. The Contractor shall replace material that fails the tests.

F. Remove and replace new or existing material that is damaged in storage or in the performance of Work unless specifically accepted in writing by QA Representative.

G. No Work shall be performed at the Site if the Contractor's Superintendent, or his designee, is not present at the site.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

3.1 DATA MANAGEMENT AND DOCUMENTATION

A. General

The Contractor will be responsible for documenting that the quality control requirements of this project have been addressed and satisfied. The Contractor will be responsible for ensuring that the quality control documentation is complete and accurate with adequate documentation.

The Contractor's QC reporting will include descriptive remarks, data sheets, and logs to verify that the monitoring activities have been carried out in accordance with the Specifications and Construction Quality Control Plan. Performance standards established for the project will need to be demonstrated. The Contractor will also maintain at the job site a complete file of plans and specifications, the Contractor HASP, the Contractor's checklists, test procedures, daily logs, and other pertinent materials that will be used to document conformance with the approved design drawings and specifications for this project.

The Contractor will prepare progress logs and test data sheets daily, as appropriate and provide such information as attachments to the Daily Field Reports. At a minimum, these reports will include the following information:

- Descriptions and locations of ongoing construction;
- Data on weather conditions;
- Equipment and personnel in each work area, including subcontractors;
- Descriptions and specific locations of areas, or units, or work being completed, tested and/or observed and documented;
- Locations where any tests and samples were taken; and a summary of tests results;
- Calibrations or recalibrations of test equipment, and actions taken as a result of recalibration;
- Delivery schedule of relevant construction materials received, including quality control documentation for appropriate materials;
- Decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality; and,
- Signature.

The QA Representative will be made aware of any significant recurring non-conformance. The QA Representative will work with the Contractor to determine the cause of the non-conformance and recommend appropriate changes, such as revisions to procedures or specifications.

B. Design and/or Specification Changes

Design and/or specification changes may be required during construction. In such cases, the Contractor will notify RMC, who will coordinate with the Engineer regarding the nature of and reasons for the required change. Design and/or specification changes will be made only with the written agreement of RMC (following review and consultation with all appropriate parties such as the Engineer, USEPA and IDEM), and, if necessary, will take the form of an addendum to the Corrective Measures Design.

C. Contractor's Final QC Report

At the completion of the Work, the Contractor's Project Manager will submit to RMC a final QC report. This report will include:

- A certification that the Work has been performed in compliance with the Corrective Measures Design
- Physical sampling and testing have been conducted at the appropriate frequencies;
- Observation logs and testing data sheets including the Contractor's sample location plans; and
- As-Built drawings (See Section 01050).

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1: GENERAL

1.1 DESCRIPTION

A. Work included:

The Contractor shall provide temporary facilities and controls needed for the performance of its Work including, but not necessarily limited to:

1. Temporary utilities such as water, electricity, and telephone;
2. Field office for the Contractor's personnel;
3. Sanitary facilities;
4. Enclosures such as tarpaulins, barricades and canopies;
5. First-aid facilities;
6. Temporary fencing and other safety devices for pedestrian and vehicular traffic as well as isolating the construction area;
7. Entry Control limiting access to authorized construction personnel;
8. Dust and Pollution Control and Monitoring Equipment;
9. Erosion and Sediment Control;
10. Water Control;
11. Health and Safety measures as required by the Contractors approved Health and Safety Plan;
12. Creation and maintenance of access roads.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01300 - Submittals

C. Section 01351 – Health and Safety Plan Requirements

D. Division 2 of these Specifications

1.3 SUBMITTALS

A. The Contractor shall provide a plan showing the proposed layout for the temporary facilities for review and approval by RMC prior to start of mobilization.

1.4 PRODUCT HANDLING

The Contractor shall maintain and protect all temporary facilities and controls in proper and safe condition throughout progress of the Work.

1.5 TEMPORARY UTILITIES AND SERVICES

A. Water: Water lines are in place and operable up to the fire hydrant situated near pump house #4, although service has been discontinued. In order to perform the Work of the Contract, the Contractor shall be responsible for restoration of water service to the site prior to commencement of remedial activities and shall be responsible for discontinuation of water service following successful completion of remedial activities. The Contractor shall absorb all costs associated with water service restoration and cancelation, and the costs of the water usage during any phase of the Work of the Contract.

The Contractor shall also provide, maintain, and pay for potable water (e.g., bottled water) for each of the Contractor supplied office trailers and for all work personnel.

B. Sanitary Facilities:

1. The Contractor shall provide, and pay for all portable sanitary accommodations for all Contractor personnel on the project, including

RMC representatives, and regulatory agencies. Facilities shall be located in areas convenient to personnel and approved by RMC. The Contractor is to provide at least one portable sanitary unit per trailer and one unit shall be provided for every fifteen (15) employees of the Contractor. The units shall be cleaned and maintained by the Contractor in a sanitary condition and at a minimum frequency of twice per week.

C. Temporary Power and Lighting:

1. The Contractor shall provide all temporary electricity necessary to complete the Work as detailed in the Specifications and on the design drawings. The Contractor may connect to local electrical sources or may provide on-site generators; however, the temporary electrical supply method must be approved by RMC and must also meet federal, state, and local regulations. The Contractor's electrical service shall not be subject to voltage fluctuations capable of damaging electrical equipment.

2. The Contractor shall provide temporary lighting for the support (i.e., trailers), access, parking, and active work areas. The provision of lighting in the active work areas does not necessarily permit the Contractor to work after sunset without the prior written approval of RMC and the Engineer.

3. The Contractor shall pay all costs associated with the utility tie-ins, physical plant, maintenance of system throughout construction, power usage during the work, removal of same at project completion and any other items necessary in providing temporary power and light. The temporary power and lighting system shall at all times conform with the applicable codes and regulations of OSHA, NEMA, UL, and the local municipality.

D. Telephones:

1. The Contractor shall make necessary arrangements and pay costs for installation, maintenance and operation of direct line (non pay type) telephone services in the Contractor's field office at the site. Telephone service in main office trailer shall be suitable for conferencing during weekly progress calls.

1.6 ACCESS, STORAGE AND PARKING AREAS

A. The Contractor shall establish a construction Compound. The Contractor shall submit to RMC a plan layout of the Compound for RMC approval prior to mobilization.

B. The Contractor shall coordinate the provision of utility services for all trailers and be responsible for all installation charges, removal costs at Project completion, and any periodic or other charges incidental to the provision of those utility services.

C. Contractor shall provide lighting for the Contractor compound areas.

D. Routes of ingress and egress within the Site shall be clearly marked and protected by the Contractor as required by the Section 02100. Temporary roads to the construction areas shall be constructed and maintained by the Contractor. These roads may be extended and relocated as Work progresses, as long as traffic flow is unimpeded. The Contractor shall maintain both access and temporary construction roads in adequate condition such that vehicular and pedestrian traffic can safely and easily negotiate the roads. Conditions which should be corrected by the Contractor shall include, but are not be limited to, excessive ponding water, excessive dust generation, potholes, or excessive mud, snow, or debris. All access and temporary construction roads shall be removed and restored

E. Upon final acceptance of the Work, the Contractor shall clean up the work areas and leave them in a neat and orderly condition. The Contractor shall dismantle and remove all temporary fencing and barricades and other temporary items installed, unless otherwise directed by RMC. Repair damaged areas to their original condition.

1.7 FIELD OFFICES AND SHEDS

A. Contractor's Field Office:

Furnish and maintain a field office with a telephone at the site during the entire period of construction. Keep readily accessible at the field office copies of both the Contract Documents and the latest approved shop and working drawings.

B. RMC's Field Offices

The Contractor shall provide at least 100 sf of field office space for use by RMC's on-site representatives. Such space may be located in the same trailer as the Contractor's field office but must include a lockable door, desk surface with at least one 2-drawer file cabinet and two chairs.

1.8 ENCLOSURES AND TEMPORARY FENCING

A. The Contractor shall provide all storage necessary for materials and equipment associated with the Work, as specified in individual specification sections and as recommended by the respective manufacturers. Protection for materials, equipment, and completed Work shall be provided by the Contractor in addition to any special protection where specified in individual specification sections.

1.9 TEMPORARY SIGNAGE (CONSTRUCTION)

A. The Contractor shall provide, maintain, and pay for all barricades, temporary fencing, railings, warning lighting, signage and other similar items necessary to protect all areas required and to comply with OSHA guidelines for safe working environments for both site personnel and onlookers and to prevent unauthorized entry onto the Site or work zones.

1.10 PROTECTION OF NEW AND EXISITNG IMPROVEMENTS

A. The Contractor shall protect all areas on and off the Site that may be damaged by its activities. This shall include, but not be limited to, streets, roads, monitoring wells, Site entrances, existing fence and gates, railroad right-of-ways, existing drainage features, adjacent properties, previous site improvements, sidewalks, utilities, trees, plants, lawns or other maintained areas. The Contractor shall also protect all off-site and clean on-site areas from cross-contamination by vehicular tracking, erosion, or any other mechanism, manmade or natural. Any areas or items that are impacted by the Contractor's activities shall be repaired or replaced at the Contractor's expense.

B. Temporary and removable protection shall also be provided, as necessary. The Contractor shall control activity in the immediate work area to prevent damage or contamination. Traffic should be prohibited from completed or protected areas. Any damage to materials, equipment or completed Work shall be repaired or replaced at the Contractor's expense. The Contractor shall delineate work zones using temporary orange snow fence and posts with warning signs as approved by RMC and the Engineer.

1.11 POLLUTION AND DUST CONTROL

A. The Contractor shall supply all expertise, labor, equipment, and materials necessary to control the spread of contamination and to control the generation of excessive noise, dust or odor emissions. Dust control shall be conducted in order to maintain all work areas free from dust which would contribute to air pollution. Approved temporary methods of stabilization consisting of sprinkling, water treatment, or similar methods will be permitted. Sprinkling, where used, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

B. The Contractor shall provide and maintain decontamination stations for the proper decontamination of all equipment, personnel, and materials leaving a contaminated work zone. This includes, but is not limited to, all pumps, power washers, storage tanks and the decontamination pad.

C. The Contractor shall provide all necessary expertise, supervision, labor, materials, and equipment and shall perform all work activities in such a manner as to minimize the amount of noise, dust, or odor generated from the Site. The Contractor shall also ensure that the levels of noise, dust, and odor and methods of mitigating them are in accordance with federal, state and local regulations.

1.12 EROSION AND SEDIMENT CONTROL

A. The Contractor shall provide Erosion and Sediment controls as required by the Corrective Measures Design to protect the Site from erosion and to prevent contaminated particles from exiting the Site.

1.13 WATER CONTROL

A. The Contractor shall provide water control throughout the duration of the Contract in accordance with the Water Management During Construction Section 02715.

1.14 SECURITY

A. The Contractor shall be responsible for maintaining existing security fencing and gates for adequate protection of and restriction of access to all areas of the site, including support zones and active/inactive work areas, by unauthorized persons or vehicles throughout the Work. Security maintenance shall protect the Work and existing facilities from unauthorized entry, vandalism, or theft.

B. The Contractor shall be solely responsible for security of its equipment and work. RMC currently maintains a part-time security service consisting of one to three site visits by an unarmed guard between dusk and dawn. RMC does not maintain responsibility for protection of Contractor equipment, materials, or completed work.

1.15 PROGRESS CLEANING

A. The Contractor shall incorporate a cleaning program for the support facility and work areas of the Site on a periodic basis. The cleaning methods and frequency shall be adequate to maintain all areas of the Site, including maintaining the interior of trailers free of waste materials, debris, and rubbish, and generally safe, clean, organized and workable. Upon final acceptance of the Work, the Contractor shall clean up the work area and leave it in a neat and orderly condition.

B. The Contractor shall provide trash service involving at least one eight (8) cubic yard dumpster to be emptied once a week. The Contractor may need to provide more extensive trash collection measures during peak periods of construction so that the dumpster is not overflowing at any point in time.

1.16 FIRE PREVENTION CONTROL

A. The Contractor shall take all precautions necessary to prevent fires and explosions. All open flame, welding, and heating operations shall be performed in accordance with OSHA standards. The Contractor shall provide and maintain dry chemical type fire extinguishers in the immediate vicinity of any flame or spark producing operations and also in each of the office trailers. All flammable liquids shall be stored in accordance with OSHA standards. Gasoline shall be transported and stored in OSHA approved containers only.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SPECIFICATIONS

DIVISION 2

SECTION 02100

SITE PREPARATION

PART 1: GENERAL

1.1 DESCRIPTION OF WORK

At the initiation of the Work, the Contractor will perform a variety of tasks that are necessary to prepare the proposed work areas, control access and traffic patterns, provide storm water management and erosion control, and prevent cross-contamination. Site preparation activities will include establishment of the various zones, security fence, utility location and abandonment, clearing and grubbing, installation of erosion control measures, implementation of dust control measures and air monitoring, mobilization and activation of temporary water treatment equipment and stake-out of proposed work areas.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01050 - Field Engineering

C. Section 01351 - Health and Safety Plan Requirements

D. Section 01500 - Construction Facilities and Temporary Controls

E. Section 02110 - Site Clearing and Grubbing

F. Section 02115 - Erosion and Sediment Control Measures

G. Section 02209 - Excavation/Handling/Placement

H. Section 02715 - Water Management During Construction

I. Section 02936 - Restoration

J. Section 02999 - Dust Control and Air Monitoring

1.3 QUALITY ASSURANCE

The QA Representative shall field check stake-out and grade controls established by the Contractor's Surveyor for the proposed soil removal limits and evaluate the adequacy of erosion control measures prior to beginning excavation activities. QA Representative shall also confirm that the measures required as part of this Section are fully installed and functional prior to initiation of work. Site preparation activities may be sequenced based on the Contractor's means and methods, provided necessary measures are fully operational as determined by the QA Representative. All products must meet specific parameters contained in these Specifications. If deemed necessary by the USEPA, IDEM, or RMC, additional measures (such as erosion and sediment control, construction safety fences, drainage control measures, etc.) will be added, and/or materials not meeting the requirements of the Specifications will be removed by the Contractor.

1.4 SUBMITTALS

A. Prior to initiating any on-site activities, the Contractor shall have received final acceptance of the Contractor's Health and Safety Plan (Section 01351) by the USEPA, IDEM and RMC.

B. Contractor shall have received written approval of the submittals required for site preparation activities (including erosion and sediment control products Section 02115) and all subcontractors. RMC will not be responsible for delays or costs associated with the Contractor's failure to make required submittals or provide acceptable materials and qualified subcontractors.

C. If the Contractor chooses to establish temporary facilities and/or controls differing from those presented on Sheet 4 of the design drawings, he shall present the alternate layout on a markup of Sheet 4 for approval by RMC prior to commencing mobilization. All field offices, equipment and employee parking, material storage and sanitary facilities must be located on the RMC property unless explicit written authorization is obtained by the Contractor from the property owner and the Contractor can demonstrate to RMC, USEPA and IDEM that location of such facilities at the proposed alternate location will not cause adverse environmental impacts or potential health and safety hazard. The only temporary facilities that are anticipated to be situated on non-RMC property are erosion control and safety measures, pumps and piping for transferring storm water to the temporary treatment system on the RMC property, and temporary loading and decontamination stations.

PART 2: PRODUCTS

2.1 CONSTRUCTION SAFETY FENCE

A. Temporary Construction Safety Fence – Construction safety fence shall be 48-inches high, orange plastic safety fence. Contractor may re-use construction safety fence for the project provided the fence maintains its original strength and durability.

B. Metal T-Posts – Posts utilized for temporary construction safety fence shall be metal T-posts having a minimum length of 60-inches. If reinforcing steel or similar steel rods are utilized as fence posts the Contractor shall provide and maintain protective caps on all such post. T-posts do not require protective caps.

2.2 CONTAMINANT REDUCTION ZONES

A. Coarse Aggregate

Coarse aggregate used for the vehicular Contaminant Reduction Zones (CRZ) shall be clean hard durable stone matching AASHTO No. 1 size requirements. The stone shall be of such quality that it will not disintegrate on exposure to water or weathering.

B. Filter Fabric

The Vehicular CRZ shall be underlain by a non-woven geotextile filter fabric material possessing a minimum grab strength of 200 lbs/in and minimum puncture strength of 90 lbs.

2.3 EROSION AND SEDIMENT CONTROL

A. Erosion and Sediment Control measures shall meet the requirements established in Section 02115 of the Specifications.

2.4 SITE SECURITY FENCE

A. Site Security Fence shall meet the requirements established in Section 02831 of the Specifications.

PART 3: EXECUTION

3.1 FAMILIARIZATION

A. The Contractor's superintendent will participate in a site walk with the QA Representative prior to the commencement of site preparation activities. Representatives from the USEPA and IDEM will also be invited to participate in the site walk. The site walk will be intended to familiarize the superintendent with beginning conditions and RMC's expectations for the project. During the site walk, site conditions will be reviewed relative to the Contractor's proposed employee parking areas, support zones, material and equipment staging areas, exclusion zones, and vehicle and personnel decontamination stations. Minor modifications in the location or configuration may be made based on the conditions observed as agreed to by RMC.

3.2 ESTABLISHMENT OF DESIGNATED ZONES

A. Support Zone - The Contractor shall establish a Support Zone for staging of construction equipment, and materials and products brought to the site. The SZ must be located outside of the Exclusion Zone and Contaminant Reduction Zone. The support zone shall be adequately sized to facilitate staging of equipment and to take delivery of materials. The support zone shall be situated on-site such that traffic routes and excavation areas are not impeded. Any fuel storage shall be located within the support zone and the Contractor shall implement proper spill containment.

B. Contaminant Reduction Zones – The Contractor shall provide Contaminant reduction Zones (CRZ) at established locations where the equipment and personnel will be transitioning from the exclusion zones to the support zones. The CRZs will provide facilities for workers to don and remove work boots and pads for removing potentially contaminated soil from the wheels/tracks and frames of vehicles. The Contractor's Site Health and Safety Plan will provide specific information regarding the specific configuration and facilities to be provided. Sheet 4 shows one primary CRZ location (near the former battery breaker) and one short term CRZ location for use during cleanout and closure of the lagoon. These locations have been selected to remain usable for as long as possible based on the assumed sequence of construction. The locations of the CRZ may shift during the course of the work depending on the means and methods to be employed by the selected Contractor. Alternate locations must be pre-approved by the Engineer. Additionally, as detailed in Section 02209, work along the driveway, South Arlington Avenue and the railroad right-of-ways is expected to proceed rapidly and is expected to be performed using techniques for excavation and vehicular loading that will not require entry into the work zone except by the excavator bucket and workers. Therefore, only temporary CRZ facilities will be required for personnel and hand equipment.

C. Exclusion Zone – Prior to the start of intrusive construction activities, the Contractor will clearly mark the limits of proposed remediation, as presented on sheet 4 of the Design Drawings, unless otherwise approved by the Engineer to accommodate the Contractor's proposed means and methods. Personnel and equipment entering and exiting the Exclusion Zone (EZ) will be required to pass through the CRZ. The Contractor shall reduce the area of the exclusion zone as work progresses to protect remediated areas from possible recontamination. The work within the right-of-way along Arlington Avenue will be protected on one side by the exiting fence along the RMC property line and on the opposite side by the traffic control devices required as part of the highway occupancy permit. Construction safety fence shall function as a temporary EZ fence to protect open excavation areas during non-working hours.

3.3 UTILITY LOCATION AND ABANDONMENT

A. The Contractor is responsible for the identification and protection of utilities at the site and all off-site work zones. The Contractor is required to perform notifications utilizing the Indiana One-Call for location of public utilities and to engage a private utility locator to clear excavation areas for utilities. Known utilities include water and natural gas that enters the site from South Arlington Avenue; water service that enters the site from Big Four Road; sanitary sewer service entering the site from South Arlington Avenue; water, gas and telecommunications (including fiber optic cable) in the right-of-way of South Arlington Avenue; fiber optic cables in the railroad right of ways, natural gas lines from Big Four Road to Citizens Gas; and overhead power and communications lines.

B. Electrical service will be required to maintain operation of the storm water pump houses until completion of remediation and regrading of the site to provide drainage as described in Section 02715 at which time the pump houses will be demolished. The Contractor will be responsible for disconnecting power between the pump houses and the Indiana Power and Light (IPL) poles. If power is disconnected before use of the pump houses is completed, the Contractor shall provide temporary power connection until the pump houses are no longer required.

C. The sanitary sewer enters from South Arlington Avenue at the northeast corner of the property. Since cessation of plant operations, the sanitary sewer has been used exclusively for discharge of storm water to the POTW. RMC will submit a Special Discharge Application to the City of Indianapolis to allow discharge of treated decontamination water and water from active work zones. Therefore, the sanitary sewer must be protected and until completion of remedial activities or temporarily re-piped to maintain discharge.

D. The Design Drawings indicate several groundwater monitoring wells and a former Production Well that must be abandoned. Abandonment will be completed by RMC prior to start of Corrective Measures activities.

3.4 CLEARING AND GRUBBING

A. Clearing and grubbing is required to accommodate the proposed containment cell and allow access for remediation. Clearing and grubbing may not commence until the site preparation activities protecting or servicing the area to be cleared are installed. Clearing and grubbing requirements are provided in Section 02110.

3.5 PROJECT STAKE-OUT

A. The Contractor's surveyor shall field locate the proposed limits of soil and sediment removal and the containment cell utilizing the horizontal controls identified on the Design Drawings. For control purposes the Contractor's surveyor will establish a reproducible reference grid (and/or cross-sections) in the excavation areas and containment cell to document starting ground surface elevations.

B. Proposed excavation depths are presented on Sheets 6, 7 and 8 of the Design Drawings. Actual excavation depth will be measured relative to starting ground surface utilizing the reference grid established by the Contractor's survey. The Contractor may perform his own measurements of excavation depths utilizing the grid and cross-sections established by his Professional Surveyor utilizing survey equipment and techniques approved by the QA Representative. However, the Contractor is responsible for the accuracy of such measurements. The Contractor will not be compensated for over-excavation not pre-approved by RMC.

3.6 EROSION AND SEDIMENT CONTROL

A. Contractor shall install erosion and sediment control measures (silt fence and stabilized construction entrances) as required by Section 02115 of the Specifications and as directed by RMC during the course of the work. When field conditions prohibit the installation of erosion and sediment control devices (such as for the conflict with a utility), erosion and sediment control shall be achieved through sequencing and excavation management.

3.7 TRAFFIC PATTERNS

A. The Contractor is required to implement a sequence for construction and traffic patterns for construction equipment that protects site workers and public and prevents cross-contamination. Routes within the support zones shall be confined to existing surfaces to the extent possible and delineated during site preparation activities using cones, barriers, and/or markings. Routes within the exclusion zone shall be established to avoid tracking across areas of completed remediation, prevent rutting and the generation of dust.

B. The contractor shall install an access ramp into the containment cell suitable for the construction equipment being utilized. This is expected to include some combination of geotextile fabric and crushed aggregate or recycled concrete as described in Section 02115. The temporary haul road shall be maintained during the period of containment cell filling. At the end of filling the haul road shall be removed.

3.8 CONTAMINANT REDUCTION ZONES

A. Contaminant Reduction Zones (CRZs) for vehicles exiting the the exclusion zone shall be established at the locations shown on Sheet 4 and at other locations as approved by RMC, USEPA and IDEM. CRZs shall be appropriately sized to accommodate the size and weight of construction equipment proposed for use by the Contractor but no less than 14 feet wide by 40 feet long.

B. The CRZ shall be constructed in accordance with the detail provided on Sheet 12 of the design drawings. If the CRZ is constructed on an impervious surface, the contractor shall provide measures to collect decontamination water for transfer to and processing through the temporary treatment system or direct the water into incomplete remediation areas where it will be allowed to infiltrate. On pervious surfaces the water will be allowed to infiltrate. The proposed geotextile fabric will filter the water to remove soil and sediment washed into the stone.

C. The Contractor will be required to maintain and operate the CRZ throughout the period of use. Operation will include driving vehicles from the exclusion zone onto the CRZ and cleaning the equipment, including the wheels and under carriage, using hand tools and pressures washers, or other techniques as approved by the QA Representative. Depending on the Contractor's proposed sequence of work, the CRZ may be moved/relocated as approved by the QA Representative. If the CRZ becomes clogged or is otherwise incapable of handling water created during decontamination activities or precipitation the Contractor will be required to clean out the clogged stone and or fabric and replace with clean material. Removed materials will be disposed in the Containment cell.

3.9 TEMPORARY CONSTRUCTION SAFETY FENCE

A. Temporary construction safety fence will be placed along the limits of the work zone during non-working hours in those areas outside the site security fence to provide a high visibility demarcation between the work zones and surrounding areas, and prevent access by the general public. The alignment of the temporary construction safety fence will be established in the field but shall be situated outside the remediation areas.

B. Construction safety fence shall be supported using T-posts at a maximum spacing of 10-feet on-center. T-posts shall be driven into the ground a minimum depth of 12-inches. Safety fence fabric will be fastened to the T-posts using plastic zip ties. Zip ties shall loop through holes in the T-posts. At least 4 zip ties shall be used on each post. The completed fence shall be secure and sufficiently tight to prevent sagging.

3.10 SECURITY FENCE

A. The Contractor is required to extend the security fence along the northern property boundary as part of site preparation activities except to the extent necessary to provide access to drainage ditches along railroad tracks for the purpose of remediation. Sections not completed as part of site preparation will be completed as soon as possible following completion of off-site remediation activities. See Section 02831 for additional requirements.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Work included in this section shall be performed on a lump sum basis and shall, therefore, not be measured. Erosion and sediment control, clearing and grubbing and security fence work will be measured and paid in accordance with the provisions of their relevant Specification Sections

4.2 PAYMENT

PAY ITEM	PAY UNIT PRICE
Site Preparation	Lump Sum

END OF SECTION

SECTION 02110

SITE CLEARING AND GRUBBING

PART 1: GENERAL

1.1 DESCRIPTION

A. The majority of the area proposed for remediation is clear of trees and excessive brush and it is the intent of RMC to preserve and protect mature healthy trees. Where clearing of trees or brush is necessary, it shall be performed in accordance with the procedures described herein and as requested by the QA Representative in the field.

1.2 RELATED SECTIONS

A. Section 02100 – Site Preparation

B. Section 02115 – Erosion and Sediment Control

C. Section 02209 – Excavation/Handling/Placement

D. Section 02210 - Earthwork

E. Section 02936 – Site Restoration

F. Section 02999 – Dust Control and Air Monitoring

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

3.1 GENERAL

A. Erosion and sediment controls shall be implemented prior to site clearing and grubbing as shown on Sheet 4 and required by Section 02115.

B. The Contractor shall collect miscellaneous trash and debris from surface of the Site for off-site disposal as general refuse (miscellaneous concrete and masonry rubble may remain on-site for processing with concrete rubble created during demolition of remnant structures and removal of former concrete floors and foundations). This includes trash and debris in the vicinity of the proposed containment cell.

C. The Contractor's superintendent and QA Representative shall review conditions within those areas proposed for remediation and/or construction of the containment cell, storm water management and storm drainage features and alignment of proposed security fence. At that time, trees greater than 6-inches in diameter (18-inches circumference) as measured at chest height, proposed for removal shall be clearly marked with high visibility paint. Trees to remain and be protected will be flagged using colored tape agreed upon by the superintendent and protected using construction safety fence.

D. The Contractor shall protect benchmarks, monuments, line and grade stakes, other reference points, utility lines or poles, fences, and existing pavement against damage from equipment, vehicular and pedestrian traffic, or clearing activities.

E. The Contractor will coordinate marking of trees not planned for clearing with QA Representative prior to the start of clearing.

3.2 IMPLEMENTATION

A. Grubbing shall be sequenced to minimize the amount of time between disturbance of the ground surface and remediation.

B. Clearing shall consist of the removal and handling of standing trees and snags, stumps, boulders, brush, downed timber, logs and other growth, and other objects on and above the ground surface.

C. Cleared materials shall be promptly moved to a staging area and managed in accordance with sub-section 3.3 of this section.

D. Cleared materials shall be managed to prevent the mixing of contaminated soils with cleared materials. If mixing between contaminated soils and cleared materials does occur, they must be disposed of as contaminated debris at the Contractor's expense.

E. Contractor shall segregate grubbed material generated from within the proposed removal limits from any materials generated outside the remediation limits and manage the material separately.

3.3 HANDLING OF CLEARED MATERIAL

A. Cleared materials from within the limits of the proposed work that are not mixed with soils, shall be considered free of contamination ("Clean Materials') and shall not be handled in a manner that the materials could be contaminated or come in contact with soil in areas to be excavated.

B. Clean Materials shall be ground or chipped to a maximum size of three (3) inches and stockpiled at a location outside the exclusion zone to await shipment off-site. Large diameter lumber may be staged whole and shipped off-site.

C. Grubbed materials from within the limits of the remediation and cleared materials mixed with contaminated soils shall be ground or chipped and placed in a secure location that prevents run-on and run-off of precipitation to await placement in the containment cell.

D. Trash and other debris shall be sent off-site for disposal as general refuse.

E. On-site burning of the cleared material is not permitted.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Work included in this section shall be performed on a lump sum basis and shall, therefore, not be measured.

4.2 PAYMENT

Payment for clearing shall be based on the lump sum price indicated on the bid form.

PAY ITEM	PAY UNIT PRICE
Clearing and Grubbing	Lump Sum

END OF SECTION

SECTION 02115

EROSION AND SEDIMENT CONTROL MEASURES

PART 1: GENERAL

1.1 DESCRIPTION

A. The Work covered by this section shall include furnishing, installing, and maintaining all temporary erosion and sediment control measures as required by the specifications and design drawings. This includes, but is not limited to, constructing and operating stabilized construction entrances; restricting site vehicular traffic to designated haul roads; performing watering or other means to prevent the generation of dust; and installing berms, diversions and/or silt fence between work areas. The Contractor shall, on a continuous basis, maintain and repair all existing erosion controls and any additional erosion controls throughout the Work.

B. The quantity and type of erosion control measures shown on the design drawings shall be increased or decreased at the direction of the QA Representative to comply with applicable erosion and sedimentation control regulatory requirements and the intent of the CMD and actual conditions encountered during the Work.

1.2 RELATED SECTIONS

A. Section 01351 - Health and Safety Plan Requirements

B. Section 02100 - Site Preparation

C. Section 02110 - Site Clearing/Grubbing

D. Section 02150 – Demolition of Remnant Structures

E. Section 02209 – Excavation/Handling/Placement

F. Section 02210 – Earthwork

G. Section 02936 – Site Restoration

H. Section 02999 - Dust Control and Air Monitoring

1.3 SUBMITTALS

A. Contractor shall submit manufacturer's information for the products proposed for silt fence fabric, geotextile fabric and temporary seed. Contractor shall also submit representative gradation information and the name, address and IDEM permit number of the quarry for the coarse aggregate proposed for use.

1.4 QUALITY ASSURANCE

A. The QA Representative shall review the Contractor's submittals to ensure that all materials are in accordance with the specification and the CM Work Plan. Any material found by QA Representative to be not in conformance with these specifications will be rejected and the Contractor shall remove all such materials from the Site at the Contractor's expense

PART 2: PRODUCTS

2.1 SILT FENCE

A. Silt Fence Geotextile

1. Silt fence geotextile shall be composed of strong, rot-proof synthetic fibers formed into a non-woven fabric. The fabric shall contain stabilizer and/or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat. The geotextile shall conform to the requirements shown in Table 1.

TABLE 1
Physical Requirements[1,2]
For Temporary Silt Fence Geotextiles

Property	Test Method	Self Supported Requirements
Grab Tensile Strength Lbs.	ASTM D4632	300 minimum[3]
Elongation at 50% minimum grab tensile strength (45 lbs.)	ASTM D4632	50 maximum
Permittivity[3] (sec^1)	ASTM D4491	.01 minimum
Apparent Opening[3] Size (mm) (100 sieve)	ASTM D4751	0.149 maximum
Ultraviolet[4] Degradation	ASTM D4355	Minimum 70% strength retained

NOTES:

1. Geotextile physical properties and a letter from the supplier certifying that its geotextile meets specification requirements shall be submitted to the QA Representative.

2. Minimum - Use value in weaker principal direction. All numerical values represent minimum average roll value (i.e., test results from any sampled roll in a lot shall meet or exceed the minimum values in the table). Lot sampled according to ASTM D4354.
3. Permittivity & AOS indirectly relate to filtration performance of silt fence fabrics. Values presented reflect minimum criteria of products currently used.
4. Strength retained after 500 hours of ultraviolet exposure when tested according to ASTM D4355. This method specifies tensile testing by 2-inch strip (or ravelled strip) for both control and exposed samples.

B. Silt Fence Posts

Posts shall be either steel or wood having a minimum length of 18 inches plus burial depth. Posts shall be of sufficient strength to resist damage during installation and to support applied loads.

2.2 CONSTRUCTION ENTRANCES AND HAUL ROADS

A. Coarse Aggregate

Coarse aggregate used for the construction entrances shall be clean hard durable stone matching AASHTO No. 1 size/gradation requirements. The stone shall be of such quality that it will not disintegrate on exposure to water or weathering. The source of the aggregate shall be from a quarry operation permitted by Indiana Department of Environmental Management and acceptable for general construction use.

B. Filter Fabric

Construction entrances and haul roads shall be underlain by a non-woven geotextile filter fabric material possessing a minimum grab strength of 200 lbs/in and minimum puncture strength of 90 lbs.

2.3 TEMPORARY SEED

If construction schedule prevents final seeding as described in Section 02936 or temporary seeding is deemed necessary for any other reason, such temporary seeding shall be performed using annual ryegrass (Lolium multiflorum). Seed shall be packaged for use during the year of construction activity.

PART 3: EXECUTION

3.1 FAMILIARIZATION

Prior to implementing any erosion and sediment control measures, the Contractor shall become thoroughly familiar with the Site, the Site conditions, applicable local, state and federal standards for soil erosion and sediment control, and all portions of the work pertaining to and/or related to this section.

3.2 SILT FENCE INSTALLATION

A. A trench six (6) inches wide and six (6) inches deep shall be excavated with equipment such as a trenching machine or motor grader; or, if equipment cannot be operated at that location, by hand.

B. Post installation shall start at the center or the low point (if applicable) with the remaining posts spaced a maximum of six (6) feet apart. Posts shall be installed with at least a minimum of eighteen (18) inches in the ground. When stake depths are less than eighteen (18) inches, but greater than twelve (12) inches, the post spacing shall be reduced to four (4) feet apart. When the posts can not be driven twelve (12) inches, the Contractor shall pre-drill the post location to facilitate installation to the target (12 to 18 inch depth).

C. Geotextile shall be securely attached to the post by wire, cord, staples, or other acceptable means as approved by the QA Representative. The Contractor shall overlap adjacent geotextile sections as shown on Sheet 12.

D. The trench shall be backfilled so that no stormwater and/or sediments can pass under the barrier. Backfill material shall be properly compacted to provide a stable anchor for the geotextile.

E. At the time of installation, geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, storage, or installation or at anytime is deemed so by the QA Representative.

3.3 STABILIZED CONSTRUCTION ENTRANCES

A. Stabilized construction entrances shall be installed following soil remediation at locations to be proposed by the Contractor to support his proposed approach and sequence of work. The subgrade shall be prepared by grading to smooth irregularities and remove vegetation or stumps (not addressed by clearing or soil removal).

B. The geotextile filter fabric shall be placed immediately after subgrade preparation with each section of fabric having a minimum overlap of 1 ft.

C. Placement of the stone shall immediately follow installation of the geotextile in a method to prevent damage to fabric. Entrances shall have stone thickness as shown on the details.

3.4 TEMPORARY VEGETATIVE COVER

A. Any completed restoration areas not protected by stone shall receive a temporary vegetative cover if they will not be permanently seeded within twenty (20) calendar days from completion of final grading.

B. Annual ryegrass shall be applied by broadcast seeding at a rate of 40 pounds per acre to establish the temporary vegetative cover.

3.5 MAINTENANCE AND REMOVAL

A. The Contractor shall maintain the integrity of silt fence, construction entrance and other erosion and sedimentation control measures as long as they are necessary to contain sediment associated with Work.

B. The Contractor shall inspect all temporary facilities at least daily and report the results of the inspection in the daily quality control report. Any deficiencies shall be immediately corrected by the Contractor.

C. In addition, the Contractor and the QA Representative shall make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, additional silt fences shall be installed as requested by the QA Representative. Should the silt fence become damaged or otherwise ineffective while the barrier is still necessary, it shall be repaired promptly. Sediment deposits shall be removed when the deposit reaches approximately one-half of the height of the silt fence and placed in the containment cell.

D. The temporary erosion control measures shall remain in place until the QA Representative requests that they be removed. Upon removal, the Contractor shall remove and dispose of any stone and excess silt accumulations, dress the area to give a positive aesthetic appearance, and restore all bare areas with a vegetative cover in accordance with Section 02936. Materials protecting exclusion zone areas, including silt fence materials, which are removed, shall be disposed of in the containment cell. The Contractor shall sequence work to perform the removal of controls protecting exclusion zones to ensure that placement in the cell is possible.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Silt fence shall be measured in lineal feet installed. Sediment removal shall not be measured. Measurement of temporary seed is addressed in Specification 02936. Construction entrances and decontamination pads shall be measured as units. Dust suppression will be considered incidental to other project activities and will not be measured. See Specification Section 02999 for additional information regarding dust control.

4.2 PAYMENT

Silt fence shall be paid for per lineal foot which shall include full compensation for the specified work. This payment shall be full compensation for furnishing all materials and erecting, maintaining and removing silt fence.

Payment for construction entrances and decontamination pads shall be per unit installed and shall include all stone, geotextile and other materials, labor and equipment required for installation. Payment for construction entrances, decontamination stations and temporary access road shall be made in two payments, one after installation and the second after removal of the feature and restoration of the area.

The completed work shall be paid in accordance with the following unit price schedule.

PAY ITEM	PAY UNIT
Unreinforced Silt Fence	Lineal Foot
Construction Entrance	Each
Decontamination Pad (CRZ)	Each
Haul Roads	Lineal Foot

END OF SECTION

SECTION 02150

DEMOLITION OF REMNANT STRUCTURES

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section shall include the demolition of remnant structures and pavement and the segregation, cleaning, sizing and on-site reuse of concrete and masonry rubble, and on-site disposal or off-site recycling of all other debris generated during the demolition process. The Contractor shall be responsible for furnishing all expertise, supervision, equipment, labor, material and all other services required to complete the work specified herein.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01050 - Field Engineering

C. Section 01351 - Health and Safety Plan Requirements

D. Section 01355 – Waste Management and Disposal Plan Requirements

E. Section 02100 – Site Preparation

F. Section 02115 - Erosion and Sediment Control Measures

G. Section 02209 – Excavation/Handling/Placement

H. Section 02715 - Water Management During Construction

I. Section 02936 – Site Restoration

J. Section 02999 – Dust Control and Air Monitoring

1.3 REFERENCES

40 CFR 263 - Standards Applicable to Transporters of Hazardous Waste
40 CFR 268 - LDRs - Standards for Decontamination and Disposal of Debris Contaminated by Hazardous Wastes

1.4 SUBMITTALS

Contractor shall submit bills of lading, manifests, weight tickets and certificates of disposal or recycling to the QA Representative for all materials shipped from the site.

Contractor shall submit results of all debris sample analyses (if required) at least 24 hours prior to off-site disposal, if used.

1.5 QUALITY ASSURANCE

Contractor shall ensure that demolition activities are performed in accordance with the Construction Quality Assurance Plan (CQAP). The QA Representative shall observe all sampling activities conducted by the Contractor.

PART 2: PRODUCTS

2.1 DEMOLITION EQUIPMENT

Equipment used by the Contractor for demolition activities shall be intended for such activities by the manufacturer and shall be approved by the Owner and QA Representative.

2.2 DUST SUPPRESSION MATERIALS

Dust suppression materials shall be non-toxic and biodegradable and shall be approved by RMC and QA Representative.

PART 3: EXECUTION

3.1 GENERAL

All work shall be performed in an organized, controlled, and safe manner. Such work shall not interfere with other construction operations. Blasting shall not be permitted for any demolition task. Burning of demolition debris shall not be permitted. It is the responsibility of the Contractor to conduct work in accordance with all local, state and federal regulations and to obtain all required permits prior to the start of demolition or demolition related activities.

Metal debris identified on-site shall be recycled off-site to the extent practicable. Concrete rubble and masonry shall be segregated, crushed, sampled and analyzed as specified in Section 02210. All other debris shall be transported to the Containment Cell, unless indicated by the QA Representative that off-site disposal is required. The maximum size of debris to be placed in the containment cell shall not exceed 12-inches in the longest dimension unless specifically approved by the QA Representative.

3.2 STRUCTURES TO BE DEMOLISHED

The following structures or portions thereof, decontaminated on all exposed surfaces during the 2009 facility decontamination and demolition project (except the lagoon), shall be demolished as part of the Work:

- Lagoon;
- Pump Houses 1 through 4 (including sumps);
- Former Refining Area Pit;
- Former Material Storage Building Loading Dock;
- Remnant Equipment Pedestals;
- Perimeter Wall;
- Concrete and asphalt paving;
- Concrete walls;
- Building foundations and footings;
- Miscellaneous abandoned utilities;
- Fencing; and,
- Non-active utility poles.

Concrete and masonry rubble materials (except those specifically prohibited in Section 02210) shall be reduced to 4" - minus and stockpiled in 200 cy piles in a designated area for characterization sampling for possible reuse during site restoration. If characterization sampling demonstrates that the material meets the requirements established in Section 02210, the material shall be utilized for site restoration. If the material fails to meet the requirements established in Section 02210, the material will be placed in the containment cell.

The Contractor shall ensure that the demolition activities do not damage or impact any surrounding completed work. The Contractor shall implement dust suppression methods during demolition to prevent the migration of fugitive dust particles from the Site. Dust control and air monitoring shall be conducted as required by Section 02999.

3.3 PREPARATION

Prior to any demolition activity, the Contractor shall perform the following activities:

A. Install all erosion and sediment control measures in accordance with Specification 02115;

B. The Contractor shall remove and stockpile all miscellaneous debris. All debris shall be reduced in size using standard construction procedures to 12" minus where applicable and stockpiled for future placement within the Containment Cell.

C. The Contractor shall verify that all utility connections to the former buildings have been disconnected and abandoned per Specification 02100;

D. The Contractor shall install all necessary high-visibility fencing, ribbons, or other work area markings such that unauthorized personnel do not enter the work area.

3.4 DUST CONTROL

The Contractor shall provide all expertise, supervision, labor, materials and equipment necessary to prevent the release of fugitive dust emissions that result from demolition activities. Visible airborne dust shall not be permitted. Contractor may use water, foam or other no-toxic and biodegradable dust suppression agents as approved by the QA Representative. The QA Representative shall judge the effectiveness of dust control measures.

3.5 DEBRIS DISPOSAL

Metal debris shall be segregated from non-metal debris. Each shall be disposed of in accordance with the following requirements:

A. Metal debris that can be readily cleaned to a clean surface in accordance with 40 CFR 268.45 shall be cleaned, sorted, sized for transportation and sort for scrap, if feasible. Copies of weight tickets and certificates of recycling shall be submitted to the QA Representative for project documentation. Off-site recycling facilities shall be approved by the RMC.

B. Non-metal debris that cannot be recycled shall be placed in the Containment Cell.

Materials proposed for off-site disposal (if any) shall be approved by the QA Representative prior to shipment. Unapproved loads shall not be sent off-site. Copies of all bills-of-lading shall be provided to the QA Representative immediately after shipment and weight tickets and certificates of disposal or recycling within two weeks of shipment. RMC must sign all manfests.

3.6 CONCRETE AND ASPHALT REMOVAL

Asphalt located within excavation areas shall be removed, sized to 12"-minus and placed within the Containment Cell. Concrete removal shall be performed to minimize cross-contamination with underlying soils, separated for sizing and characterization sampling pursuant to Section 02210.

3.7 SAMPLING AND ANALYSIS

The Contractor is responsible for collection and analysis of all materials proposed for off-site disposal.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Demolition activities will not be measured.

4.2 PAYMENT

Demolition of the pump houses will be paid for on a structure by structure basis. Concrete and asphalt pavement, foundations and miscellaneous pedestals will each be paid for on a lump sum basis. Demolition of the former loading dock will be paid for on a lump sum basis. Concrete and asphalt demolition costs shall include sorting, sizing (i.e. crushing) and segregating. Miscellaneous rubble and concrete not approved for use as fill shall be placed in the containment cell at no additional charge.

PAY ITEM	PAY UNIT
Pumphouses	Each
Loading Dock	Lump Sum
Concrete and Asphalt Pavement	Lump Sum

These bid items shall include all necessary work including but not limited to demolition, segregation of materials, recycling, sampling, analysis and handling. Demolition of miscellaneous utilities and utility poles will be considered incidental to excavation activities and will not be tracked or paid for separately.

END OF SECTION

SECTION 02209

EXCAVATION/HANDLING/PLACEMENT

PART 1: GENERAL

1.1 DESCRIPTION

A. The Work covered by this section includes, but is not limited to, the furnishing of all labor, supervision, equipment, materials and supplies necessary to perform excavation, handling and placement of contaminated soils, sediment and miscellaneous debris and rubble encountered during the course of the work.

B. The specific areas of soil and sediment proposed for removal are designated on Sheets 6, 7 and 8 of the design drawings. Information related to the stakeout of proposed excavation areas are provided in Section 02100.

1.2 RELATED SECTIONS

A. Section 01050 – Field Engineering

B. Section 01351 - Health and Safety Plan Requirements

C. Section 02100 - Site Preparation

D. Section 02110 - Site Clearing and Grubbing

E. Section 02115 - Erosion and Sediment Control Measures

F. Section 02150 – Demolition of Remnant Structures

G. Section 02715 – Water Management During Construction

H. Section 02936 – Site Restoration

I. Section 02999 – Dust Control and Air Monitoring

1.3 SUBMITTALS

A. The Contractor shall provide two weeks prior to the start of intrusive field activities a narrative description of the proposed sequence of construction listing the order of excavation areas. The sequence described in the narrative shall correspond to the construction schedule submitted under Section 01300 and include information regarding the means and methods by which the Contractor will perform removal from the proposed remediation areas (excavation), movement/transport from the excavation area to the Containment Cell or restoration area (for materials that test clean) (handling) and spread and compact the excavated materials within the Containment Cell (placement).

1.4 QUALITY ASSURANCE

A. RMC will provide a full-time Quality Assurance (QA) Representative during corrective measures. The QA Representative will be responsible for implementing the QA procedures detailed in the Construction Quality Assurance Plan (Attachment D). The Contractor will be responsible accommodating the QA Representative during the collection of field measurements and confirmation of information.

PART 2: PRODUCTS

2.1 GENERAL

A. The Contractor's bid shall identify products and equipment proposed for excavation, handling and placement. Such items must be appropriate for accomplishing the proposed work in accordance with generally accepted industry standards for similar work.

PART 3: EXECUTION

3.1 GENERAL

A. The vertical and horizontal limits of proposed soil and sediment excavation represent initial required removal depths based on sampling activities completed during the Closure Investigation and RCRA Facility Investigation. The Contractor shall implement appropriate controls to ensure attainment of the target removal limits. Copies of the design drawings in AutoCAD will be provided to the Contractor for use in obtaining coordinates necessary for stakeout and establishment of grids.

B. The Contractor shall take appropriate measures to control at all times dust and dirt, both wind blown and from machine operation. The Contractor shall monitor air quality in and around the work area. Dust control and air monitoring requirements are provided in greater detail in Section 02999 of these Specifications.

C. Prior to intrusive activities, the Contractor shall evaluate proposed excavation and removal areas with the QA Representative for protection and delineation pursuant to the relevant sections of the Specifications, including but not limited to Section 02100 - Site Preparation; Section 02115 - Erosion and Sediment Control Measures; and Section 02715 – Water Management During Construction.

D. As described in greater detail below, initial excavation activities will be limited to soil removal within the footprint of the proposed Containment Cell. Full-scale excavation activities may not proceed until completion of Containment Cell construction unless specifically approved by the Engineer in writing following a demonstration by the Contractor that a partially completed configuration will provide adequate capacity and containment.

3.2 CONTAINMENT CELL PREPARATION

A. As depicted on Sheets 5 and 7, soil remediation is required within a portion of the Containment Cell footprint before construction of the containment cell can be performed. In addition, up to 4 feet of cutting is required to achieve the cell design bottom.

B. The soil removal limits for excavation area NW, as depicted on Sheet 7, shall be staked out pursuant to the Specifications. The target removal depth in excavation area NW is 12-inches below the existing ground surface. Soil excavation will be performed across the western portion of the NW excavation area.

C. After attainment of the target removal limits, confirmatory sampling will be performed following the post-excavation sampling techniques described in the Construction Quality Assurance Plan (CQAP).

D. Excavated soil from area NW shall be placed in a temporary stockpile on the eastern portion of excavation area NW or an alternate location approved by the Engineer. The stockpile shall be covered with plastic sheeting and be protected by straw bales or silt fence around the base.

3.3 EXCAVATION

A. The Contractor will be responsible for determining the specific sequence of the proposed removal activities, but unless approved otherwise by the Engineer, the general sequence shall begin at the highest elevations on-site and progress outward. This concept envisions work progressing as follows:

i. Excavation and removal of lagoon contents, liner system and adjacent soil excavation areas inside of fence;
ii. Soil excavation within HWMU excavations areas (Sheet 6), Corrective Measures excavation area FL-4B and balance of NW;
iii. Soil excavation within Corrective Measures excavation areas along western portions of site (FL-1 through FL-5, starting at FL-5 and working north);
iv. Soil/sediment excavation along South Arlington Avenue north of main entrance;
v. Soil/sediment excavation along main driveway;
vi. Soil/sediment excavation along South Arlington Avenue south of main driveway;
vii. Soil/sediment excavation along railroad spur (both sides);
viii. Soil/sediment excavation along CSX right-of-way north of site and onto Citizens Gas property; and,
ix. Soil excavation between Citizens Gas property line fence and railroad tracks along Big Four Road.

B. Excavation equipment shall be appropriately sized for the nature of the work being performed and conditions in the work area. All equipment shall be in good working order and well maintained with no fuel, oil or other leaks.

C. To the extent possible, excavation shall be performed in a manner that avoids entry of excavation or transportation equipment into completed areas or areas not designated for remediation.

D. Temporary stockpiles may be utilized for staging remediated materials awaiting loading into trucks but such pile may only be located within the limits of contiguous excavation areas where remediation has not been completed. If temporary stockpiles must be located on previously remediated or areas not designated for remediation, the Contractor shall protect the ground surface against cross-contamination using plastic sheeting beneath pile. After the pile is removed the plastic sheeting shall be removed and ground surface inspected by the QA representative. If the QA Representative suspects cross-contamination, the underlying soil shall be scraped to remove suspected cross-contamination.

E. Contractor shall monitor removal depths while work is progressing to avoid over or under excavation. Removal depths shall be measured from the starting ground surface, such that bottom of the excavation replicates the beginning ground surface.

F. Area of standing water shall be removed from proposed excavation areas pursuant to the requirements of Section 02715 or allowed to infiltrate prior to the start of excavation activities.

G. Excavation shall be sequenced to maintain uninterrupted access to the Containment Cell.

3.4 HANDLING

1. The Contractor shall load excavated soil, sediment and debris (remediated materials) directly into trucks for transport to containment cell.

2. The Contractor's trucks shall be in good working condition with locking tailgates to prevent the spillage of materials while in transit. The trucks shall be staged near the work area for loading and within the exclusion zone whenever possible. Trucks moving across the Site within the exclusion zone shall follow the designated exclusion zone access roads.

3. Trucks shall travel at speeds that do not create fugitive dust. If dust is observed coming from the trucks wheels that, in the opinion of the QA Representative, is or could potentially affect surrounding areas the Contractor will be required to cease transport activities until the truck route can be re-wet to prevent dusting. Whenever possible, trucks shall travel from the active excavation areas to the Containment Cell without leaving the exclusion zone.

4. When the truck is not staged for loading within the exclusion zone (such as during off-site excavation activities and excavation along the main driveway), the Contractor shall establish a temporary loading area, which includes the use of plastic sheeting placed beneath the truck. When a loaded transport vehicle prepares to leave the temporary loading area the truck must be inspected for loose materials on its sides, wheels and undercarriage or material piled above the top of the sides. When such materials are found, the Contractor shall remove the

materials to the satisfaction of the QA Representative. Trucks traveling outside the exclusion zones must be covered.

3.5 PLACEMENT

1. Excavated materials shall be delivered to the Containment Cell for placement and compaction. To the extent possible, dumping shall be performed in a manner that does not require tracking of the trucks across previously placed soil. The Contractor shall provide a designated piece of equipment, such as a small dozer for movement of excavated materials in the cell.

2. During placement, excavated materials shall be spread in uniform lifts with a maximum loose lift thickness of 18-inches. Each lift shall be compacted until visually stable as determined by the QA Representative. Rubble material placed in the cell shall not be greater than 12 inches thick and shall be placed to prevent voids. Liner materials removed from the lagoon or temporary covers placed over the former MSB and Battery Breaker floors shall be placed flat to prevent bunches and not less than 20 feet from the design exterior slopes. The liner material disposed in the cell shall be intentionally sliced to prevent the accumulation of precipitation on the liner material.

3. At the end of each work day, or when work is stopped because of precipitation, the fill surface shall be smooth rolled to prevent infiltration and promote runoff. The fill surface shall be sloped to direct runoff towards a low point where the contractor can collect and manage storm water pursuant to Specification section 02715.
4. When filling progresses above elevation 839, the Contractor shall perform filling to create a drainage diversion around the perimeter of the cell to protect against over-topping.

5. The Contractor shall maintain the fill surface in a condition that is sufficiently moist to prevent the generation of dust during filling operations or during wind.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement of removal, handling, and placement of soils, sediment, and waste in the Containment Cell shall be based on cubic yards excavated as determined by pre- and post-excavation surveys. Contractor's surveyor shall calculate removal volumes using average end area method (soils) or similar method approved by the QA Representative. Wastes and debris generated from decontamination and demolition activities will not be measured. Water management shall be considered incidental to the work.

4.2 PAYMENT

Removal, handling, and placement of soil, sediment and waste materials will be compensated using the unit price indicated on the bid sheet. Handling and disposal of waste and debris from demolition activities will not be paid as a separate item, said costs shall be included in those bid items.

PAY ITEM	UNIT
Removal/Handling/Placement Soils and Sediment	Cubic Yard

END OF SECTION

SECTION 02210

EARTHWORK

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section shall include, but not be limited to, the furnishing, excavating, hauling, handling, placement, and compaction of fill soil for excavation backfill, general site grading, and soil cover layer on the cap. Specific requirements associated with final surface restoration of the work areas, using coarse aggregate, seeding, or sod is provided in Section 02936 (Site Restoration).

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01050 - Field Engineering

C. Section 01300 - Submittals

D. Section 01400 - Quality Assurance/Quality Control

E. Section 01351 - Health and Safety Plan Requirements

F. Section 02100 - Site Preparation

G. Section 02110 - Site Clearing and Grubbing

H. Section 02115 - Erosion and Sediment Control Measures

I. Section 02209 - Excavation/Handling/Placement

J. Section 02715 - Water Management During Construction

K. Section 02720 - Post-Remediation Stormwater Management

L. Section 02936 - Site Restoration

1.3 REFERENCES

ASTM D421 - Test Method for Dry Preparation of Soil Samples for Particle Size Analysis and Determination of Soil Contents

ASTM D422 - Test Method for Particle-Size Analysis of Soils

ASTM D1557 -	Test Method for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb (4.5-kg) Hammer and 18-inch (475-mm) Drop
ASTM D2922 -	Test Method for Density of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)
ASTM D3017 -	Test Method for Moisture Content of Soil and Soil Aggregate In-Place by Nuclear Methods (Shallow Depth)

1.4 DEFINITIONS

Structural Soil Fill - Material placed within areas where removal of soil, structures, or other material has occurred as part of the closure and/or corrective action activities. This also includes filling to construct the containment cell berm and berms for the proposed stormwater basins.

General Site Fill - Material placed in conjunction with cutting and filling cut from one area within the RMC property boundary and placed within another.

Cap Soil Fill - Material to be placed as cover soil within the containment cell cap.

Granular Fill - Material used for backfill beneath the groundwater table. Granular fill shall not be used for backfill above the groundwater table, unless approved in writing by the QA Representative.

1.5 SUBMITTALS

Prior to the start of on-site activities, the Contractor shall submit to the QA Representative for review and approval, a copy of analytical laboratory testing for each soil fill material. The Contractor shall also submit for each imported fill material gradation, plasticity index (P.I.) and Modified Proctor test results for every 3,000 cubic yards of each type of soil fill material placed or when a change in the character of the material is noted by the QA Representative. In addition the Contractor shall provide internal shear strength and cohesion testing (as well as interface friction testing required by Section 02755) for the cap soil fill. During execution, the contractor shall provide field compaction test reports and bills of lading for all delivered materials with the Daily Field Reports.

1.6 QUALITY ASSURANCE

Quality assurance of earthwork operations shall be performed in accordance with the Construction Quality Assurance Plan (CQAP). As described in the CQAP, earthwork will be monitored and tested by the Contractor's QC personnel, with review and oversight by the RMC's QC Representative.

PART 2: PRODUCTS

2.1 STRUCTURAL SOIL FILL

Structural soil fill shall be used to fill excavations up to the proposed subgrade for proposed surface restoration, construction of the containment cell berm, and construction of the storm water management basin berms. The material shall be capable of supporting construction loads to assure stability. The structural soil fill shall also be free of organic matter, debris, roots, vegetation, or other deleterious material. Imported structural soil fill shall be classified as non-plastic, as defined by ASTM D 2487 Soil Classifiaction Group (such as SW, SM or SC). Maximum particle size for imported structural soil fill shall be 3-inches. Imported soil fill shall be analyzed for TAL Metals/TCL VOCs and SVOC compounds and shall be less than IDEM RISC Default Residential Standards for Direct Contact and Soil to Groundwater, whichever is more stringent.

Materials generated from within the RMC property boundary (including crushed/recycled concrete) may be utilized as unrestricted structural soil fill if they are approved by the QA Representative as geotechnically acceptable and are tested once every 500 cubic yards for antimony, arsenic, cadmium, lead and selenium and proven to have concentrations below the standards established for HWMU closure. If such materials are geotechnically acceptable to the QA Representative, but have lead concentrations >400 mg/kg and <920 mg/kg, while meeting the HWMU closure requirements for the other parameters they may be utilized as structural soil fill outside the footprints of the HWMU.

2.2 GENERAL SITE FILL

Following completion of proposed remediation and receipt of acceptable confirmatory sampling results, the Contractor may cut into areas protruding above the proposed subgrade for final grading and utilize cut materials as fill in low areas. The cut material will be considered General Site Fill and must meet the general geotechnical requirements for structural soil fill and be approved by the QA Representative but will not require analytical testing. General site fill cut from within the limits of the HWMUs may be used anywhere within the RMC property, but general site fill cut from outside the footprints of the HWMUs may only be utilized outside the footprints of the HWMUs.

2.3 CAP SOIL FILL

Cap soil fill placed as part of the cap shall meet the specified requirements for structural fill above except that material shall fall within the USCS soil classification of CL, ML, SC, or SM, be free of rock fragments larger than 2 inches and have a minimum cohesion at optimum moisture of 300 psf. The finished geomembrane subbase must be hard, uniform and smooth, and be free of soil, gravel or other particles larger than 2 inch diameter or of angular shape. Cap soil fill at the time of placement shall be between -5% and +3% of the optimum moisture content before completion. The cap soil shall have a minimum angle of internal friction of 28 degrees and a minimum wet unit weight at 95% compaction of 120 pounds per cubic foot (pcf). Cap soil fill shall be analyzed for TAL Metals/TCL VOCs and SVOC compounds and shall be less than IDEM RISC Default Residential Standards for Direct Contact and Soil to Groundwater, whichever is more stringent.

2.4 GRANULAR FILL

Granular Fill shall be hard, durable crushed stone or gravel with 100 percent passing the 4" sieve and no greater than 10 percent passing the #4 sieve. Granular fill shall be analyzed for TAL Metals/TCL VOCs and SVOC compounds and shall be less than IDEM RISC Default Residential Standards for Direct Contact and Soil to Groundwater, whichever is more stringent unless the material is produced by an IDEM permitted quarry and is approved by IDOT for unrestricted use. The contractor may also utilize crushed/recycled concrete derived from on-site for use as granular fill with the approval of the geotechnical characteristics by the QA Representative and are tested once every 500 cubic yards for antimony, arsenic, cadmium, lead and selenium and proven to have concentrations below the standards established for closure of the HWMUs.

PART 3: EXECUTION

3.1 GENERAL

All fill shall be placed to the lines and grades as shown on the Drawings. Survey controls required for earthwork placement shall be established by an Indiana licensed professional surveyor retained by the Contractor. Controls shall be established based on the vertical and horizontal reference systems established by the Contractor's Surveyor at the start of the project.

The Contractor is responsible for ensuring that all earthwork materials meet this Specification. Any material not in conformance will be rejected and removed from the Site at Contractor's expense.

3.2 FAMILIARIZATION

Prior to the start of earthwork activities, the Contractor shall become thoroughly familiar with the Site, the Site conditions, and all portions of the work falling within this section. The Contractor shall carefully inspect the completed work of other sections and verify that all work is complete to the point where the work covered by this section may commence. Any conflicts or concerns with work completed which may impact earthwork should be brought to the RMC's attention in writing.

3.3 SITE PREPARATION

The Contractor shall maintain the temporary erosion and sediment controls installed prior to excavation as described in Section 02115 of the Specifications.

3.4 FILL AREA PREPARATION

Material shall not be placed in any fill zone until the subgrade of that zone has been suitably prepared, and has been approved by the QA Representative. The foundation for the fill shall be prepared by leveling and rolling, where applicable, so that the surface materials of the foundation will be compact and well-bonded with the first layer of fill as herein specified for the subsequent layers of fill. Any areas which are noted to pump, deflect, or be unsuitably soft, as determined by the QA Representative, shall be excavated and replaced with suitable material or stabilized by other means, at the discretion of the QA Representative. Under no circumstance shall backfill be placed on peat, marsh deposits, topsoil or any other organic strata. Areas where fill is to be placed shall be clean, and free of standing water, vegetation or soft zones.

3.5 PLACEMENT OF FILL

Brush, roots, sod, organic matter and other unsuitable materials shall not be placed within any fill area (excluding Containment Cell contents). The Contractor shall remove and dispose of all unsuitable items within the fill encountered during dumping or spreading. All fill shall be placed in layers and compacted. Loose lift thickness shall not exceed 12 inches, except for the cap soil fill which shall be placed to achieve a single compacted lift thickness of 18-inches.

Excavations which extend into the groundwater table shall be backfilled with granular fill to the groundwater table to create a stable surface for placement of subsequent layers of structural soil fill. If the compacted surface of a fine grained material is determined to be too smooth to bond properly with the succeeding layers, it shall be loosened by harrowing or by any other methods as approved by the QA Representative before the succeeding layer is placed.

Placement of fill materials shall be suspended when, in the opinion of the QA Representative, the climatic conditions are unsatisfactory for placing fill to conform to these Specifications.

The Contractor shall maintain and protect all fill areas in a satisfactory condition at all times until final completion and acceptance of the work. The Contractor shall excavate and remove, from the fill, any material which the QA Representative considers unsuitable and shall also dispose of such material and refill the excavated areas as directed.

The Contractor may be required to remove any fill material placed outside of the lines and grades shown in the Drawings at no expense to the RMC.

When constructing fill against an existing slope (such as embankment filling), the slope shall be properly benched according to standard construction practice. The QA Representative shall monitor benching to assure that the bench is at least 2 feet and not greater than 4 feet into the existing slope for every 2 feet thickness of material placed. Cap soil fill shall be placed using techniques and sequencing that will not damage the cap geosynthetic components or cause sliding.

During earthwork operations, all fill materials shall be monitored by the Contractors QC personel with oversight by the QA Representative to determine conformance to the project Specifications. Additional testing shall be performed whenever a significant material variation is observed or as required by the CQAP.

3.6 COMPACTION

The Contractor shall compact all soil fill and granular fill. All compaction equipment shall be suitable to the slope and area conditions of the Site, and shall be subject to approval by the QA Representative. If necessary, hand-operated compaction equipment such as mechanical tampers shall be used for working in confined areas. Compaction of fill shall produce a stable material that does not exhibit pumping or rutting as determined by the QA Representative based on visual observations. At the end of each day's construction activities, completed lifts or sections shall be sealed by rolling with a rubber tired or smooth-drummed roller or by backdragging with a bulldozer. Density testing shall be conducted by the Contractor's QC personnel using nuclear density gauge or similar approved methods every 1,000 sf of material placed per lift (approximately 1 test every 37 cy). A minimum of one test shall be conducted per lift, regardless of lift size. Additional testing will be performed if in the opinion of the QA Representative test results are marginal or stability of the compacted material based on visual observations is suspect. Materials shall be compacted until a density 92% of the Modified Proctor density is obtained.

The Contractor shall present nuclear density gauge test results in the daily QC report. Subsequent lifts shall not be placed until compaction test results meet the minimum requirements and approval is received from the QA Representative. Areas of failing tests shall be re-compacted or the moisture content of the fill material adjusted until test results pass.

Granular fill placed below the water table shall be compacted using the backhoe bucket or similar method. Nuclear density gauge testing is not required for granular fill, but stability must be approved by the QA Representative based on visual observations.

3.7 WATER MANAGEMENT

The Contractor shall be responsible for managing all precipitation, surface water, and groundwater entering the work areas. Contractor shall provide, maintain, and operate pumps and other equipment as necessary pursuant to Section 02715 - Water Management During Construction.

3.8 PROTECTION OF FINISHED WORK

The Contractor shall implement appropriate measures to protect completed work areas and construction materials from damage by Site activities, vandalism, flooding or other forces whether natural or man made. If damage occurs to work areas the Contractor shall make all repairs and replacements necessary, as determined by the QA Representative, at no additional cost to the RMC.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Structural soil fill, granular fill, and general soil fill shall be measured by cubic yards of fill in place. In place volumes shall be determined by standard survey techniques. Any fill placed for the convenience of the Contractor shall not be measured. Cap fill shall be measured on a square yard basis.

4.2 PAYMENT

Payment for structural soil fill, granular fill, cap soil fill and general soil fill shall be in accordance with the unit price schedule. The prices shall include all equipment, labor, materials, and expertise required to perform the fill in accordance with the CMD, or as directed by the QA Representative.

Prices shall also include, but will not be limited to, borrow area selection, preconstruction testing, every 3,000 cy ongoing testing, subgrade preparation, placement, compaction, trimming, field quality control, surveys, and maintenance and protection of final grades.

All work associated with furnishing and hauling material will not be paid separately but shall be included in the unit price.

No additional payment will be made for removing approved fill material which is rendered unsuitable after placement or replacement; for removal, hauling, disposal and replacement of objectionable fill material; nor for any fill material placed outside of the lines and grades as shown on the design drawings or approved by the QA Representative.

Completed work shall be paid in accordance with the unit price schedule.

PAY ITEM	PAY UNIT
Structural Soil Fill	Cubic Yard
General Soil Fill	Cubic Yard
Granular Fill	Cubic Yard
Cap Soil Fill	Square Yard

END OF SECTION

SECTION 02715

WATER MANAGEMENT DURING CONSTRUCTION

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section shall include, but not be limited to, the management of any storm water, surface water, decontamination water, or groundwater that flows or seeps into active work areas or other staging and support areas and surface water flow within creeks and ditches. The work includes the maintenance of silt fence and diversions around excavations to control run-on, continuous diversion of water within ditches during times of active flow, and installation and maintenance of measures to prevent transport of soil, waste, or sediment to downstream areas. Also included are the collection, management, treatment and discharge of water (including groundwater dewatering) from within work areas to the POTW in accordance with a Special Discharge Permit.

The Contractor shall be responsible for handling all water and groundwater as required to complete the work in a neat and dry condition and as detailed in these Specifications. The Contractor shall provide all expertise, supervision, labor, materials, and equipment necessary to perform the work as specified herein. The Contractor is responsible for preventing cross-contamination of areas of the Site not proposed for removal or already remediated.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01050 - Field Engineering

C. Section 01300 - Submittals

D. Section 01400 - Quality Assurance/Quality Control

D. Section 01351 - Health and Safety Plan Requirements

F. Section 02100 – Site Preparation

G. Section 02110 – Site Clearing and Grubbing

H. Section 02115 - Erosion and Sediment Control Measures

I. Section 02209 - Excavation/Handling/Placement

J. Section 02210 – Earthwork

K. Section 02720 - Post-Remediation Stormwater Management

L. Section 02936 - Restoration

1.3 SUBMITTALS

The Contractor shall submit a general description of the procedures for diversion and management of flow in ditches, storm water, decontamination water, and groundwater as part of the narrative description for construction sequencing included as part of the construction schedule. The Contractor shall also submit detailed information regarding the proposed treatment system, including treatment equipment, size and number of tanks, chemicals, pre- and post-treatment analytical methods and contingencies for handling treated water that fails discharge criteria after treatment.

1.4 QUALITY ASSURANCE

Quality assurance for water management operations shall be performed in accordance with the Construction Quality Assurance Plan (CQAP). As described in the CQAP for water management, the operations will be monitored by the QA Representative to ensure that work areas are free of surface water to the extent practical. The QA Representative shall periodically monitor the water management systems to ensure that they are adequately maintained.

PART 2: PRODUCTS

Any products used by the Contractor to temporarily divert, manage, or handle storm water, surface water, decontamination water, and groundwater shall be approved by the QA Representative and shall meet the requirements of the CM Design. Pumps, hoses and tanks shall be of adequate size to accommodate the anticipated flows and volumes.

PART 3: EXECUTION

3.1 GENERAL

The Contractor shall manage all water, including surface water, groundwater, decontamination water, and water within creeks and ditches, for the duration of the project in accordance with all local, state, and federal regulations and any and all permits obtained by the RMC or Contractor. Any discrepancy regarding management of water shall be resolved by the QA Representative.

Management features shall not be removed until restoration is complete and the QA Representative has approved removal of the features. The Contractor is responsible for ensuring that all water management operations meet this Specification and any activities not in conformance will be stopped and any costs due to delays will be at the Contractor's expense.

3.2 STORMWATER MANAGEMENT

The Contractor shall be responsible for keeping areas where construction activities are being performed dry to the extent necessary required for completion of the work and for removing storm water from the active work areas, if water does not infiltrate. The Contractor shall divert runoff water from entering active remediation areas using temporary erosion controls as necessary. Any storm water that does not infiltrate within work areas shall be pumped from the area and managed in accordance with Section 3.7.

3.3 GROUNDWATER

The Contractor shall anticipate groundwater flow into the deeper excavations (below elevation 838). Any groundwater removed from excavations shall be managed in accordance with Section 3.7.

3.4 DECONTAMINATION WATER

Water generated during decontamination of personnel and equipment that does not infiltrate into un-remediated areas shall be collected and managed in accordance with Section 3.7.

3.5 CREEKS AND DITCHES

Water within creeks and ditches shall be managed by the Contractor during remediation and restoration. Removal and construction in dry conditions is preferred. The Contractor will be required to prevent the transport of contaminated sediments downstream of the work area, prevent cross-contamination of clean areas, minimize the amount of water within the work area using sand bag diversions or other QA Representative approved techniques to temporarily control flow. Liquids removed from the work area shall be managed in accordance with Section 3.7.

3.6 SEDIMENT AND REMEDIATED SOIL DEWATERING

Liquids drained from sediments and other wastes shall be collected and managed in accordance with Section 3.7.

3.7 MANAGEMENT OF WATER

Surface water, storm water, decontamination water, and groundwater shall be collected, treated and discharged to the POTW. The Contractor is responsible for providing all collection areas, sumps, pumps, hoses, tanks container and other equipment necessary to collect and manage water. The Contractor shall provide tankage for storage of water prior to and after treatment.

The Contractor shall treat all collected water until the requirements of the permit are met.

3.8 TREATMENT SYSTEM

The Contractor shall submit details for the proposed treatment system with their bid. The treatment system, at a minimum, shall include filtration and other means of removing the target metals such as pH adjustment, additives for coagulation and/or flocculation, ion exchange and settling. The treatment system shall be temporary and include a means for management of sludges. Sludges shall be placed in the Containment Cell. Sludges generated after capping shall be disposed off-site at a facility approved by the RMC. The treatment system shall include a flow meter with totalizer and to record total volume. Records shall be provided in the Contractor's daily QC report. The Contractor shall submit a description of all proposed equipment, the minimum and maximum design flow rate, the source and Material Safety Data Sheets for all additives.

Treatment shall be conducted in a batch process. After treatment, water shall be stored in a tank until post-treatment results have been reviewed by the QA Representative and the water has been approved for discharge. Post-treatment samples shall be analyzed for pH, lead, arsenic, zinc and TPH at a frequency of once per 30,000 gallons, or once per batch, whichever is more frequent. Treated water shall be approved by the QA Representative for discharge to the POTW.

The Contractor's QC personnel shall record the volume and flow rate of each batch, the dates of treatment, sampling and discharge, and the associated post-treatment analytical data in the daily QC report. Batches which do not meet the surface water standards shall be retreated and resampled.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Handling and management of surface water, storm water, decontamination water, and groundwater in and around the work areas is considered incidental and shall not be measured or paid for as a separate item. Handling of water within creeks and ditches shall be considered incidental to sediment removal activities.

Treatment of water shall not be measured.

4.2 PAYMENT

The treatment of water, including re-treatment if necessary, shall be paid for on a lump sump basis on a percent completion basis as determined by the QA Representative.

PAY ITEM	PAY UNIT
Water treatment	Lump sum

END OF SECTION

SECTION 02720

POST-REMEDIATION STORMWATER MANAGEMENT

PART 1: GENERAL

1.1 DESCRIPTION

This section covers work associated with the installation of the proposed storm water management basins, their outlet structures, endwalls, drainage channels and outlet protection/rip rap aprons. The Contractor shall provide all labor, material, equipment and expertise necessary to complete the required grading, excavations, installations and restoration.

1.2 RELATED WORK

A. Section 01050 - Field Engineering

B. Section 01300 - Submittals

C. Section 01351 - Health and Safety Plan Requirements

D. Section 02100 - Site Preparation

E. Section 02115 - Erosion and Sediment Control Measures

F. Section 02209 - Excavation/Handling/Placement

G. Section 02210 – Earthwork

H. Section 02715 – Water Management During Construction

I. Section 02836 - Restoration

1.3 DEFINITIONS

ASTM - American Society for Testing and Materials

CQAP - Construction Quality Assurance Plan

OSHA - Occupational Safety and Health Administration

1.4 QUALITY ASSURANCE

QA/QC activities for storm water and erosion control features are the responsibility of the Contractor. Products used for construction of storm water systems shall comply to specific parameters contained in the Specifications for those materials.

1.5 REFERENCES

ASTM C76 - Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

ASTM D421 - Test Method for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants

ASTM D422 - Test Method for Particle-Size Analysis of Soils

ASTM D2487 - Procedure for Classification of Soils for Engineering Properties

1.6 SUBMITTALS

Contractor shall submit pipe manufacturers recommended installation procedures to QA Representative for review and approval.

1.07 PRODUCT HANDLING

All products shall be handled in accordance with manufacturers' recommendations.

PART 2: PRODUCTS

2.1 STRUCTURAL FILL

Structural fill shall be used for backfilling storm water piping and structures where crushed stone is not required. Structural fill shall meet the requirements of the earthwork section of these specifications (Section 02210).

2.2 BEDDING

AASHTO #57 crushed stone shall be used for the RCP pipe bedding, base support for endwalls, and backfill where required.

2.3 PIPE

A. The reinforced concrete pipe used for the proposed storm water management basin discharge pipes shall conform with ASTM C76 Class III concrete pipe. The pipes shall be twelve (12)-inch or fifteen (15)-inch (as specified on the Design Drawings), respectively, in diameter with bell and spigot fittings.

2.4 ENDWALLS

Endwalls shall be reinforced precast concrete structures suitable for use with fifteen (15)-inch diameter and twelve (12) inch diameter RCP pipe.

2.5 RIP-RAP

All rip-rap stone should consist of field stone or rough unhewn quarry stone of the size and thickness indicated on the Drawings. The stone shall be hard, angular and of a quality that will not disintegrate upon exposure to water or weathering. The specific gravity of the individual stones shall be no less then 2.5.

2.6 FILTER FABRIC

The geotextile filter fabric utilized beneath the drainage channels and rip-rap aprons shall be in accordance with paragraph 2.9 of Specification Section 02936.

PART 3: EXECUTION

3.1 PREPARATIONS

A. The Contractor shall locate and mark existing utilities in and around the proposed work area. Conflicts with proposed utilities shall be resolved prior to commencement of work. Critical locations and inverts shall be confirmed prior to installation.

B. The Contractor shall have completed proposed soil remediation and clearing and grubbing activities within the footprint of the proposed storm water management basins. Silt fence shall be installed along the upslope limits of the basins to prevent the transport of sediment from potentially contaminated areas into the basins area.

C. The Contractor shall construct the proposed soil berms as a continuous earthen structure in accordance with the Earthwork Specification (Section 02210) to an elevation equal to the proposed top of pipe elevation. The Pipes will be installed following the procedures provided below when fill levels reach the top of pipe elevation, and then the remainder of the berms will be constructed to the proposed finished grade.

3.2 INSTALLATION

A. Excavation and Bedding

1. The Contractor shall ensure that the trenches are excavated to the lines and grades as shown on the Drawings

2. The trench shall be excavated in such a manner as to be safe for personnel to enter the trench for installation of the piping. OSHA and all other applicable regulations including the Health and Safety Plan approved by USEPA shall apply to this and all site activities.

3. Construct the bedding to the full depth shown on the Construction Drawings by placing the material in maximum four (4) to eight (8)-inch layers, as applicable based on the type of compaction equipment being used. Compact each layer with a mechanical tamper. Form a cradle in the bedding material for piping by means of a template conforming to the curvature of the outside surface of the bottom of the pipe, or another approved method, to provide uniform contact under and around the pipe.

A minimum of eight (8)-inches of bedding shall be placed beneath proposed structures.

B. Pipe Placement

1. The Contractor shall excavate and construct proposed pipe as detailed on the Construction Drawings. Pipe installation shall be in accordance with manufacturer's recommendations. Lay pipe in the cradle formed as specified above with bells up grade.

2. Control the pipe alignment and grade with suitable string lines, with an electronic laser beam system, or by other acceptable methods. Laser must be utilized for slopes less than two (2) percent.

3. RCP pipe without preformed joints must be mortared before placing succeeding pipe sections. Fill voids for lift holes with mortar after pipe is placed.

4. Backfilling may proceed immediately after joints are mortared if the operation avoids joint damage, maintains pipe in proper alignment and grade, and provides satisfactory curing conditions for mortar. When permitted, either a preformed joint or caulking compound of an acceptable type may be used in place of mortar to join pipe sections.

5. At endwalls cut off exposed pipe ends flush with the structure face and finish with mortar.

C. Backfilling

Backfill shall be placed in lifts and compacted by the Contractor according to the requirement of Section 02210.

3.3 DRAINAGE CHANNELS AND OUTLET PROTECTION

Drainage channels and rip rap aprons shall be constructed to the dimensions and alignment shown on the Design Drawings. The stone used shall conform to the values shown on the Design Drawings.

END OF SECTION

SECTION 02751

CAP DRAINAGE LAYER

PART 1: GENERAL

1.1 DESCRIPTION

The Work covered by this section includes installation of the cap drainage layer for the containment cell cap systems. This includes manufacture, fabrication, packaging, delivery, and installation of all components. Specific components include the composite drainage layer (geonet/geotextile composite), perforated anchor trench drain, granular fill, and geotextile.

1.2 RELATED SECTIONS

A. Section 01050 - Field Engineering

B. Section 01300 - Submittals

C. Section 02210 - Earthwork

D. Section 02755 - Cap Barrier Layer

1.3 REFERENCES

ASTM D413 -	Test Method for Rubber Property-Adhesion to Flexible Substrate
ASTM D422 -	Test Method for Particle-size Analysis of Soils
ASTM D1682 -	Test Method for Strip Tensile Strength
ASTM D2487 -	Procedure for Classification of Soils for Engineering Purposes
ASTM D3776 -	Test Method for Mass per Unit Area (Weight) of Fabric
ASTM D4354 -	Standard Practice for Sampling of Geosynthetics for Testing
ASTM D4533 -	Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4595 -	Test Method for Tensile Properties of Geotextiles by the Wide Width Strip Method
ASTM D4632 -	Test Method for Breaking Load and Elongation of Geotextiles (Grab Method)
ASTM D4716 -	Test Method for Constant and Hydraulic Transmissivity of Geotextiles and Geotextile Related Products
ASTM D4751 -	Test Method for Determining Apparent Opening Size of a Geotextile

ASTM D4759 -	Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4833 -	Test Method for Index Puncture of Geotextiles, Geomembranes and Related Products
ASTM D5321 -	Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

1.4 SUBMITTALS

A. The Contractor shall submit Manufacturer's literature and specification for perforated piping to the QA Representative for approval. A minimum of four weeks prior to cap installation, the Contractor shall submit Manufacturer's specifications and physical property information for the composite drainage layer to the QA Representative for approval.

B. The Contractor shall have a geosynthetics testing laboratory perform shear box testing pursuant to ASTM D5321, for the soil/composite interface, composite/geomembrane interface, and geomembrane/soil interface and shall include the results with the submittal for approval by QA Representative. Shear box testing shall be run at 6 psi, 3 psi, and 1.5 psi using site specific materials.

1.5 STORAGE

The composite drainage layer rolls delivered to the project site shall be stored in their original, unopened wrapping in a dry area and protected from precipitation and the direct heat of the sun. The materials shall be stored above the ground surface and beneath a roof or other protective covering.

1.6 QUALITY ASSURANCE

Quality assurance of geosynthetic installation shall be performed in accordance with the Construction Quality Assurance Procedure.

PART 2: PRODUCTS

2.1 GEONET

A. The geonet shall be a high density polyethylene (HDPE) material with intersecting material strands creating a three dimensional structure which supports planner water flow.

B. The geonet shall conform to the following requirements or the manufacturers minimum published values, whichever is more restrictive:

Properties	Test Method	Required Value
Transmissivity (M^2/S), min.	ASTM D4716 i = 1.0 Φ = 2000 psf	1.4×10^{-3}
Tensile Strength (lb/in), min.	ASTM D1682 or D4595	22

C. Contractor shall provide conformance testing as required by Construction Quality Assurance Plan.

2.2 PIPE

The pipe used within the perimeter cap drainage system (where required) shall be a four (4)-inch perforated corrugated polyethylene tubing (Class 2 Perforations) meeting the requirements of AASHTO M25-94. The pipe shall include all appropriate connections and end protection recommended by the manufacturer and as shown on the design drawings.

2.3 GEOTEXTILE

A. The geotextile bonded to the geonet shall be a non-woven material conforming to the following requirements. Geotextile shall be heat bonded to the geonet and extend a minimum distance of 6-inches beyond the geonet at either end of the cross machine direction.

Properties	Test Method	Required Value
Grab Strength (lbs.), min.	ASTM D4632	150
Puncture Strength (lbs.), min.	ASTM D4833	75
Tear Strength (lbs.), min.	ASTM D4533	70

Mass per Unit Area (oz/sy), min.	ASTM D3776	8
Apparent Opening (US sieve No.)	ASTM D4751	70
Ply Adhesion (lbs/in)	ASTM D413	1.0

B. The geotextile wrap used for the cap edge drains shall meet the same minimum requirements but will not be bonded to the geonet.

2.4 GRANULAR FILL

Granular fill shall be used as drainage material around the piping system for the perimeter cap drain and the cap edge drain. Granular fill shall be clean, rounded material with particles not larger than 1-1/2-inch in diameter and no greater than 5 percent fines (pea gravel).

2.5 INTERFACE FRICTION

Shear box test results shall demonstrate that the composite drainage layer has the following values:

Cover Soil/geotextile side of composite	22° min.
Geotextile side of composite/textured geomembrane	22° min.
Textured geomembrane/soil	22° min.

PART 3: EXECUTION

3.1 GENERAL

A. The work shall be coordinated with placement of the HDPE geomembrane and anchor trench backfill. The cap drainage layer shall be placed directly above the HDPE geomembrane.

B. Prior to placement of the cap drainage layer, the portion of the geomembrane to be covered by the geonet/geotextile composite shall have all required documentation complete. The surface of the geomembrane shall not contain stones or excessive dust that could cause damage.

C. The composite drainage layer shall be cut, if necessary, using an approved cutter. Care must be taken to protect underlying geomembrane if the geonet or geotextile is being cut in place.

D. Equipment used to deploy the composite drainage layer shall not damage the materials or the underlying geomembrane.

3.2 COMPOSITE DRAINAGE LAYER

A. The Contractor shall keep the composite drainage layer clean and free from debris. Soils and debris shall be cleaned by the Contractor just prior to installation, as determined by QA Representative. The Contractor shall handle all rolls in a manner to ensure they are not damaged in any way. To prevent folds and wrinkles, tension should be kept on the materials. Materials shall not be placed across side slopes. Geotextile side of the composite shall be placed facing up.

B. In the presence of winds, the composite drainage layer shall be weighted with sandbags, as necessary. The Contractor shall be responsible for damage caused by wind.

C. Adjacent geonet rolls shall be overlapped at least 6-inches and secured by plastic ties approximately every three (3) feet along the roll length. Plastic ties shall be white or another bright color for easy inspection. Metallic ties shall not be allowed. The heads of the ties must fit completely into the geonet channel space so that the head of the tie does not intrude into or against the primary liner. Adjacent pieces of composite drainage layer shall have their top geotextile components lystered together after the geonet is connected and accepted by QA Representative.

D. Horizontal seams shall not be placed on side slopes greater than 5% unless approved by QA Representative in the panel placement plan.

E. Repair

Patching of the composite shall be used to repair holes, tears, and defects. Patches shall provide 6" of overlap around the repaired area and shall be held in place with plastic ties. Composite shall be removed if areas with large defects are observed. QA Representative shall determine the acceptability of the composite drainage layer.

3.3 DRAINAGE LAYER EDGE DRAIN

A. The four (4)-inch diameter perforated polyethylene pipe shall be placed in the anchor trench following placement of the cap geomembrane and geotextile wrap.

The Contractor shall place the pipe in a manner which ensures underlying materials are not damaged. Endcaps shall be placed on the upslope end of the perforated pipe. Details of the pipe layout can be seen in the Drawings.

B. Granular fill shall be placed around the pipe for drainage. Granular fill shall be placed by the Contractor in a manner which ensures surrounding materials are not damaged. Granular fill shall be placed to provide proper support for the overlying trench backfill. The QA Representative shall monitor fill placement.

3.4 OUTFALLS

Cap drain outfalls shall be installed at the locations shown on the Drawings and in accordance with the Drawing Detail.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement for payment for the composite drainage layer will be based on the actual number of square yards of covered surface area in-place.

The cap drainage layer edge drain shall be measured as lineal feet in-place and shall include required granular fill, perforated pipe, pipe fittings, geotextile and cap drain outfalls.

Granular fill will not be measured and will be considered incidental to pipe placement.

4.2 PAYMENT

All prices shall include, but will not be limited to, submittals, testing, material manufacture, packaging, delivery, and storage; deployment, patches, seams, overlaps, repairs; and cleanup.

All work associated with furnishing and hauling material will not be paid separately but shall be included in the work required, or as approved by the Resident Engineer. No additional payment will be made for removing approved materials which are rendered unsuitable after placement or replacement or for removal, hauling, disposal and replacement of objectionable materials.

The completed work as measured for the cap drainage layer shall be paid for according to the unit price schedule.

PAY ITEM	PAY UNI
Composite Drainage Layer	Square yard
Edge Drain (complete)	Linear foot

END OF SECTION

SECTION 02755

CAP BARRIER LAYER

PART 1: GENERAL

1.1 DESCRIPTION

The Work covered by this section includes furnishing the materials, equipment, labor and expertise required to supply, fabricate and install the high density polyethylene liner (HDPE) component of the containment cell cap barrier layer.

1.2 RELATED SECTIONS

A. Section 01050 - Field Engineering

B. Section 01300 - Submittals

C. Section 01351 - Health and Safety Plan Requirements

D. Section 02210 - Earthwork

E. Section 02715 - Water Management During Construction

F. Section 02751 - Cap Drainage Layer

1.3 REFERENCES

ASTM D638 -	Test Method for Tensile Properties of Plastics
ASTM D746 -	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D792 -	Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D1004 -	Test Method for Initial Tear Resistance of Plastic Film and Sheeting
ASTM D1204 -	Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D1238 -	Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer

ASTM D1505 -	Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D1603 -	Test Method for Carbon Black in Olefin Plastics
ASTM D1682 -	Test Method for Strip Tensile Strength
ASTM D1693 -	Test Method for Environmental Stress Cracking of Ethylene Plastics
ASTM D2663 -	Test Method for Rubber Compounds-Dispersion of Carbon Black
ASTM D3015 -	Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds (NSF Modified)
ASTM D4354 -	Standard Practice for Sampling of Geosynthetics for Testing
ASTM D4437 -	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
ASTM D4533 -	Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4595 -	Test Method for Tensile Properties of Geotextiles by Wide Width Strip Method
ASTM D4716 -	Test Method for Constant Head Hydraulic Transmissivity of Geotextiles and Geotextile Related Products
ASTM D4759 -	Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4833 -	Test Method for Index Puncture of Geotextiles, Geomembranes and Related Products
ASTM D5084 -	Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter
ASTM D5321 -	Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

GRI Test Method GM6 - Pressurized Air Channel Test for Dual Seamed Geomembranes
NSF Standard 54(1991) Flexible Membrane Liners

1.4 SUBMITTALS

A. Bid Submittal

The Manufacturer and Contractor shall submit proof of qualifications with bid documents. These Submittals shall include the following:

1. Manufacturer: The Manufacturer shall submit a Quality Control Manual, a list of material properties, and a list of completed facilities totaling 5,000,000 square feet (list should specify facility name, location, date of installation, owner name, designer, Contractor, as well as the name and telephone number of a contact at the facility who can discuss the project).

The manufacturer shall also provide a minimum ten (10) year material warranty.

2. Contractor: The Contractor shall submit certification that the Installation Supervisor and Master Seamer have reviewed the Construction Drawings, the Construction Quality Assurance Plan and these Specifications. The Contractor shall also submit a copy of the Manufacturer's approval letter or license, qualifications resumes for the Installation Supervisor and Master Seamer, proposed seaming method descriptions, detailed quality control procedures and a list of completed facilities totaling 1,000,000 square feet each of polyethylene geomembrane (list should specify facility name, location, Manufacturer, date of installation, designer, and the name and telephone number of a contact at the facility who can discuss the project).

B. Post-Contract Award Submittal

After the contract award, the geomembrane Contractor shall submit a Panel Layout Plan to the QA Representative for approval. This plan shall be submitted at least two weeks prior to delivery of the geomembrane to the site.

C. Interface Testing Submittal

The Contractor shall have an independent geosynthetics testing laboratory perform shear box testing pursuant to ASTM D5321 for the interfaces and confining pressures identified in Section 02751.

1.5 PRODUCT HANDLING

Transportation and handling of the geomembrane shall be the responsibility of the Contractor. The Contractor shall provide all necessary equipment and assure that personnel are properly trained for handling of the geomembrane. Geomembrane rolls shall be stored in an area which provides protection from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or any other damage. Seriously damaged rolls, as determined by QA Representative, shall be rejected.

The geomembrane shall not be folded. Folded material shall be rejected.

1.6 QUALITY ASSURANCE

Quality assurance of geomembrane installation shall be performed in accordance with the enclosed Construction Quality Assurance Plan.

PART 2: PRODUCTS

2.1 RAW MATERIAL

The geomembrane shall be produced from raw materials, which may include the polymer resin, plasticizer, fillers, anti-degradants and processing aids. The resin used in production of the HDPE geomembrane shall meet the following requirements:

TEST	METHOD	REQUIREMENT	NOTES
SPECIFIC GRAVITY	ASTM D1505	>0.940	1 & 2
MELT INDEX	ASTM D1238	<0.4 g/10 min.	1 & 2 (Condition E Max)
CARBON BLACK CONTENT	ASTM D1603	2 to 3%	2

(1) Measure prior to adding carbon black.
(2) Test shall be performed at a rate of at least 1 per resin batch.

2.2 GEOMEMBRANE ROLLS

A. The geomembrane used at the site shall be a textured 60 mil high density polyethylene (HDPE). HDPE rolls shall meet the following requirements:

1. Condition: The geomembrane surface shall not have striations, roughness, pinholes, bubbles, staple marks, folds, or any other damage.

2. Properties: The geomembrane, as delivered to the site, shall meet the following physical and index property requirements or the manufacturer's minimum published values, whichever is more restrictive. Adherence to this requirement shall be made a condition of the material purchase order:

Required Material Properties of HDPE

Properties	Test Method	60 mil textured
Thickness (mils), max.	ASTM D1593	60
Density (g/cc), max.	ASTM D792 or D1505	0.940
Tensile Properties	ASTM D638-NSF Modified	
1. Strength at Yield (lb/in. width) min.		130
2. Strength at Break (lb/in width), min.		243
3. Elongation at Yield (percent), min.		13
4. Elongation at Break (percent), min.		560
Tear Resistance (lb), min.	ASTM D1004	45
Dimensional Stability	ASTM D1204	+/-3.0
(% change), max.	100°C, 1 hr	
Puncture Resistance (lbs)	ASTM D4833	80
Carbon Black Content (%), range	ASTM D1603	2.0-3.0
Carbon Black Dispersion	ASTM D3015-NSF Modified	A1, A2

* Values obtained from NSF International Standard 54 Flexible Membrane Liners

2.3 EXTRUDATE BEADS AND/OR ROD

All extrudate shall be compatible with the HDPE geomembrane specified. Extrudate shall be from the same Manufacturer and of the same resin type as the geomembrane rolls.

2.4 GEOTEXTILE

The geotextile to be placed beneath the geomembrane on top of the stabilized soil shall be a non-woven material conforming to the following requirements.

Properties	Test Method	Required Value
Grab Strength (lbs.), min.	ASTM D4632	200
Puncture Strength (lbs.), min.	ASTM D4833	100
Tear Strength (lbs.), min.	ASTM D4533	80
Mass per Unit Area (oz/sy), min.	ASTM D3776	8

PART 3: EXECUTION

3.1 PREPARATION

Contractor and QA Representative shall inspect the surface of the stabilized soil prior to placement of the geotextile. The surface shall be dry, and free of sharp stones or protruding objects. The surface have been roughed using raking or other methods acceptable to the QA Representative.

3.2 GEOMEMBRANE ROLL CONFORMANCE

The Contractor shall have an independent laboratory perform confirmatory testing of the HDPE geomembrane rolls. Test shall include density (ASTM D792 or D1505, thickness (ASTM D1593), tensile characteristics (ASTM D638-NSF Modified), tear resistance (ASTM D1004), dimensional stability (ASTM D1204) and carbon black content (ASTM D1603). A roll shall be considered a production unit and a shipment to the site shall be a lot. Conformance shall be determined in accordance with ASTM D4759 once for every 100,000 sf of material installed.

3.3 GEOMEMBRANE AND GEOTEXTILE PLACEMENT

A. Panel Layout

1. A field panel is the unit area of geomembrane which is to be seamed in the field, i.e., a field panel is a roll or a portion of a roll cut in the field.

2. At least four (4) weeks prior to construction, the Contractor shall provide the QA Representative with drawings of the area to be covered showing the orientation of all geotextile and geomembrane panels (i.e., panel layout plan). In general, seams shall be oriented parallel to the slope, i.e., oriented along, not across, the slope. Whenever possible, horizontal seams shall be located not less than five (5) feet from the toe of slope. In corners and odd-shaped geometric locations, the number of field seams shall be minimized.

3. Each panel shall be given an "identification code" (numeric or alpha-numeric) consistent with the layout plan. This identification code shall be agreed upon by the Contractor and QA Representative. The code shall be as simple and logical as possible. Identification codes shall be used for all project records.

4. Each seam shall be given an identification code consistent with the layout plan. The seam identification system should differentiate between seam types, where possible. The seam identification system shall be compatible with the panel numbering system. The identification codes shall be used for all project records.

B. Panel Placement

1. QA Representative shall verify that panels are installed at the locations indicated in the Contractor's layout plan, as approved or modified.

2. Geotextile panels shall be installed from top of slope and adjoining panels shall be sewn together. Geotextile panels shall be installed one at a time and each panel shall be seamed immediately after its placement. Adjacent panels shall be overlapped a minimum of twelve (12) inches. The sewn seam shall consist of a prayer stitch with nylon thread. Geomembrane placement shall follow immediately behind geotextile deployment. QA Representative may allow placement of additional panels; however, all panels placed must be seamed and properly anchored by the end of the

day. The geotextile shall not be allowed to get wet. QA Representative shall record the roll number, identification code, location and date of installation for each geomembrane panel placed.

3. The Contractor shall advise the QA Representative and the RMC of any and every change in the schedule.

4. Geomembrane placement shall not proceed at an ambient temperature below 0°C (32°F) or above 40°C (104°F). Ambient temperature shall be measured approximately one (1) foot above the liner. Placement shall not be performed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds. QA Representative shall be the sole judge as to whether or not placement conditions are acceptable. QA Representative shall also verify that the subgrade has not been damaged by adverse weather conditions.

C. Geosynthetic Handling - The Contractor shall assure the following during placement:

1. Any equipment or tools used shall not damage the geotextile or geomembrane by handling, trafficking, leakage of hydrocarbons, or other means.

2. No personnel working on the geotextile or geomembrane shall smoke, wear damaging shoes, or engage in other activities which could damage the materials.

3. The method used to unroll the materials shall not cause scratches, crimps, cracks, or breaks in the geomembrane and shall not damage the geotextile.

4. The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). If warranted, intentional wrinkling of the geomembrane to compensate for expansion/contraction is allowable. Locations and dimensions of these wrinkles shall be detailed by the Contractor on the Geomembrane Layout Plan submitted to QA Representative.

5. Depressions in the compacted subgrade causing bridging by the geosynthetic cap components shall be removed or leveled by the Contractor.

6. Adequate temporary loading (e.g., sand bags) not likely to damage the geosynthetics shall be placed to prevent wind uplift.

7. Direct contact with the geomembrane shall be minimized; i.e., the geomembrane in traffic areas shall be protected by geotextiles, extra geomembrane, or other suitable materials approved by QA Representative.

D. Inspection of deployed panels:

1. QA Representative and Contractor shall inspect each panel for damage immediately after placement, but prior to seaming. Panels which are seriously damaged shall be rejected, while panels with minor damage may be allowed.

2. QA Representative shall be the sole judge as to whether panels are acceptable or must be removed. QA Representative shall record all damages and advise the Contractor as to which panels, or portions of panels, shall be rejected, repaired, or accepted.

3. Damaged panels or portions of damaged panels which have been rejected shall be marked and removed from the site by the Contractor at his own cost.

4. Repairs shall be made according to procedures described in this specification or according to Manufacturer's procedures, as approved by QA Representative.

E. Field Seaming

1. The Contractor shall ensure that adjacent panels of geomembrane are overlapped by a minimum of four (4) inches. Seams aligned across the slope shall be overlapped such that the upslope panel lies over the downslope panel.

2. Seam Preparation - Prior to seaming, the following procedures shall be followed:

   a. The seam area shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign matter. Brush and wash the seam overlap portion of each panel as necessary to ensure clean contact between the panels.

b. Rolls must be laid out with no tension so that seams are aligned without wrinkles and "fishmouths".

c. For extrusion welding, grinding of the geomembrane shall be done with a hand held rotary grinder having 80 grit or finer sandpaper. Grinding shall be perpendicular, not parallel, to the seam. Overgrinding shall be avoided.

3. Weather Conditions - The following weather restrictions apply to seaming operations:

a. Seaming shall not take place during any precipitation, in the presence of excessive moisture (i.e. fog, dew, frost), in an area of ponded water or in the presence of excessive winds (unless wind barriers are provided).

b. Seaming may proceed if the geomembrane sheet temperature is above 32°F (0°C) if it can be proven via test strips that quality seams can be fabricated at lower temperatures. QA Representative shall determine the acceptability of cold weather seaming. A movable protective layer may be required below each seam overlap to prevent moisture buildup due to condensation during seaming.

c. Seaming may proceed if the sheet temperature is above 122°F (50°C) if it can be proven via test strips that quality seams can be fabricated at higher temperatures. QA Representative shall determine the acceptability of hot weather seaming. Sheet temperature should be measured by an infrared thermometer or surface contact thermocouple.

4. Test seams shall be made each day by the Contractor prior to commencing field seaming. Test seams shall be performed for each seamer working that day. These seams shall be made on fragment pieces of geomembrane liner to verify that seaming conditions are acceptable. Such test seams shall be at startups and at least once every four hours, or at the discretion of QA Representative. A field tensiometer shall be used by the Contractor to determine the peel and shear of test seams in accordance with ASTM D4437-NSF modified for 5 peel and 5 shear coupons. QA Representative shall determine the acceptability of test seams. If test seams are determined to be inadequate, appropriate corrective actions shall be taken.

5. Geomembrane seaming shall be performed by extrusion welding, extrusion flat wedge welding and/or hot wedge welding.

3.4 TESTING

A. Non-Destructive Seam Continuity Testing

1. The Contractor shall non-destructively test all field seams over their full length. The purpose of this testing is to verify seam continuity. Testing shall be done as the seaming work progresses. In addition, the Contractor shall record location, date, seam number, name of tester, and outcome of all testing. QA Representative shall monitor non-destructive seam testing.

2. The Contractor shall complete any required repairs in accordance with this specification. If repairs are required, the Contractor shall mark on the geomembrane that the repair has been made and shall document the results of non-destructive testing on the repair.

3. The following procedures shall be implemented by the Contractor at locations where seams cannot be non-destructively tested:

   a. If the seam is accessible to testing equipment prior to final installation, the seam shall be non-destructively tested prior to final installation.

   b. If the seam cannot be tested prior to final installation, acceptable seaming and cap-stripping operations shall be agreed upon between QA Representative and Contractor regarding uniformity and completeness. All such seams shall be cap-stripped with the same geomembrane.

4. Non-destructive seam testing shall be performed using either a vacuum box in accordance with ASTM D4437 or pressurized dual seam testing as outlined by GRI Test Method GM6. Other non-destructive test methods may be used, as approved by QA Representative.

B. Destructive Seam Strength Testing

1. The Contractor shall have an independent laboratory destructively test field seam samples. The purpose of this testing is to verify seam integrity.

The Contractor shall provide QA Representative with verbal results within 48 hours after seam sampling.

2. The Contractor shall submit to QA Representative one destructive seam sample per 500 feet of seam length. The exact sample location shall be selected by QA Representative. Individual samples may be taken at greater or lesser intervals. Additional destructive samples may be taken, at the discretion of QA Representative, in areas of excess crystallinity, offset welds, areas of contamination, or other visible discontinuities.

3. The sample cut shall be eighteen (18) inches wide by thirty-six (36) inches long with the seam centered lengthwise. The sample shall be cut into thirds; one section for the Contractor and two sections for QA Representative. Samples shall be cut by the Contractor under the observation of QA Representative.

4. QA Representative shall be responsible for destructive testing to assure seam integrity. Seams shall be tested by an independent laboratory for shear strength and peel adhesion. The following properties shall be required of an acceptable seam:

TEST	TYPE OF BREAK	REQUIRED STRESS
Shear Strength	FTB greater than 100% elongation ASTM 4437-NSF Modified	120 lb/in, min.
Peel Adhesion	FTB less than 30% separation ASTM 4437-NSF Modified	100 lb/in, min. (Fusion)

5. Ten one (1)-inch wide replicate specimens shall be cut from the twelve (12)-inch wide sample. Five specimens shall be tested for shear strength and five for peel adhesion. All specimens must meet minimum strength requirements and at least four of the five samples for each test must fail outside of the seam area and meet the aforementioned requirements.

6. All holes in the geomembrane resulting from seam sampling shall be immediately repaired. Patches shall be vacuum tested to assure continuity.

7. The following procedures shall apply whenever a seam sample fails a destructive test. The Contractor has two options:

a. Reconstruct the seam between the failed location and any passed test location.

b. Retrace the welding patch to an intermediate location (at a minimum distance of ten (10)-feet from the failed test location) and take a eighteen (18)-inch by twelve (12)-inch sample for an additional destructive seam test. If this sample passes the destructive seam test, then the seam shall be reconstructed or cap stripped between the passed locations. If this sample fails, then the process shall be repeated.

c. Cap strip the seam between the failed location and the closest adjacent passing test location.

d. In any case, all acceptable reconstructed seams shall be bounded by two passed test locations (i.e., the above procedure shall be followed in both directions from the original failed location). For long lengths of reconstructed or cap stripped seam, QA Representative shall take additional destructive seam samples.

3.5 DEFECTS AND REPAIRS

A. All seams and non-seam areas of the geomembranes shall be evaluated by the Contractor and QA Representative for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be broomed or washed by the Contractor if the amount of dust or mud inhibits inspection.

B. Each suspect location in seam and non-seam areas shall be non-destructively tested using the methods detailed in this specification. Each location which fails non-destructive testing shall be marked and repaired by the Contractor. QA Representative shall verify markings and repairs.

C. Repair procedures are as follows:

1. Defective seams shall be repaired by reseaming or applying a cap strip.

2. Tears or pinholes shall be repaired by extrusion welding or patching.

3. Blisters, larger holes, undispersed raw materials, and areas contaminated by foreign matter shall be repaired by patches.

4. Cap strips shall be at least six (6) inches wide and must be centered over the repair location. Cap strips shall be of the same material as the geomembrane.

5. Patches shall be round or oval in shape, made of the same materials as the geomembrane, and extend a minimum of six (6) inches beyond all edges of the defect. Patches shall be applied using extrusion fillet welding or other technique approved by QA Representative.

6. Repairs shall be numbered and logged by QA Representative and Contractor. Logging shall include repair type, welding machine used, welder, location, date of repair and details of non-destructive and/or destructive seam evaluation.

D. Each repair shall be evaluated using non-destructive testing, as described in this specification. Repairs which pass non-destructive testing shall be considered adequate. Repairs which fail non-destructive testing shall be redone and retested until a passing test is achieved. Destructive testing of long lengths of cap strips shall be performed as determined by QA Representative.

3.6 GEOMEMBRANE ACCEPTANCE

A. The Contractor shall retain all ownership and responsibility for the geomembrane until acceptance by RMC. The geomembrane shall be accepted by RMC when all of the following apply:

1. Geomembrane installation is finished.

2. All required documentation of installation is completed by the Contractor and QA Representative's certification report is completed.

3. Material conformance and destructive seam testing is completed.

4. Verification of the adequacy of all field seams and repairs, including associated testing, is completed.

5. The Contractor shall provide a final certification stating that installation has proceeded in accordance with the project specifications.

6. Written certification documents, including as-built drawings, sealed by a registered professional engineer have been received by RMC.

3.7 QUALITY ASSURANCE FOR CONTAINMENT CELL CAP SYSTEM

A. Raw Material (HDPE)

The geomembrane manufacturer is responsible for the production of geomembrane rolls from resin. Upon delivery, the following shall be furnished by the manufacturer:

1. The original resin supplier's name, resin production plant, identification (brand name/number), and productive date of the resin.

2. A copy of the quality control certificates issued by the resin supplier, noting results of density and melt index.

3. Reports on tests performed by the manufacturer to verify the quality of the resin used in the geomembrane and geonet rolls assigned to the RMC site meet the project specifications.

B. Product Certifications

The Contractor shall submit certification that all geomembrane, geotextile, and geonet rolls brought to the site meet the requirements of the specifications. For each material used at the site, the Contractor shall provide the following to QA Representative:

1. A properties sheet including specified properties and testing methods.

2. The base polymer descriptions.

3. Testing results and sample procedures from quality control testing.

4. A certification that property values given in the properties sheet are guaranteed by the manufacturer.

5. Statement certifying that no reclaimed polymer is added to the resin. Product run may be recycled, but shall only be at a proportion of 2 percent of the batch by weight.

6. Geosynthetic delivery, storage, and handling instructions.

One quality control certificate for every roll of geosynthetic used shall also be provided to QA Representative by the Contractor. This certificate shall include roll numbers and identification. The finished rolls shall be identified by a number corresponding to the particular batch of resin used. QA Representative will review all certificates for compliance with the project specifications.

The following information shall also be provided by the Contractor for any extrudate used for the project:

1. Statement of production date(s).

2. Certification stating that all extrudate is from the same manufacturer and is of the same resin type as the geomembrane seamed.

3. Copy of quality control certificates issued by the manufacturer.

C. Transportation and Handling

Geosynthetic rolls or panels shall be packaged and shipped by appropriate means so that no damage is caused.

The Contractor shall complete a Material Delivery Report (Form 1)

D. Subgrade Acceptance

1. Immediately prior to installation of the geotextile, the subbase surface shall be observed by QA Representative, Installer and Contractor. The decision to repair ruts or depressions, if any, shall be made by QA Representative. The Contractor shall repair any unacceptable subbase.

2. All recommendations and work performed on the subbase prior to installation shall be recorded. No geomembrane shall be placed on surfaces not previously found acceptable to QA Representative.

3. Surfaces to be lined shall be smooth, and free of debris, roots, and angular or sharp stones larger than 2-inch. The subbase surface shall be free from organics, trash, clayballs, sharp stones or any other deleterious material. The subbase shall be compacted in accordance with the design specifications but in no event below the minimum required to provide a

firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the subbase without causing rutting. The subbase shall have no sudden or abrupt changes in grade.

E. Anchor Trench

1. The anchor trench shall be excavated to the line, grade, and width shown on the construction drawings, prior to geosynthetic placement. The Contractor shall verify that the anchor trench has been constructed according to the project drawings.

2. The anchor trench shall be adequately drained to prevent ponding or otherwise softening of the adjacent soils while the trench is open. The anchor trench shall be backfilled by the Contractor after installation of the geotextile, geomembrane, drainage layer and perforated polyethylene pipe, as outlined in the project specifications.

F. Geomembrane Installation

1. Immediately prior to installation of the geomembrane, QA Representative shall observe the geotextile surface to insure that it is smooth, dry and free of creases, lumps and foreign objects.

2. Welding shall not take place during any precipitation, in the presence of excessive moisture, i.e., fog, dew, frost, in an area of ponded water or in presence of excessive winds (unless wind barriers are provided).

3. Seaming may proceed if the geomembrane sheet temperature is above 32°F (0°C), or if it can be proven via test strips that good seams can be fabricated at lower temperatures. QA Representative shall determine the acceptability of cold weather seaming. Sheet temperature should be measured by an infrared thermometer or surface contact thermocouple.

4. The Contractor shall be responsible for the following:

   a. No equipment or tools shall damage the membrane by handling, trafficking, or other means.

   b. No personnel working on the lining system shall smoke, wear damaging shoes, or engage in other activities that could damage the geosynthetics.

c. The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil.

d. The method used to place geomembrane panels shall minimize wrinkles. Wrinkles shall be identified as to proper location by the Installer and shall be shown on the Contractor's As-Built drawings. Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

e. Bridging shall be removed.

f. Adequate loading (i.e., sandbags) shall be placed to prevent uplift by wind. (In case of high winds, continuous loading is recommended along the edges of panels to minimize risk of wind flow under the panels).

g. Direct contact with the geomembrane shall be minimized, i.e., the geomembrane in traffic area is to be protected by geotextiles, extra geomembrane, or other materials approved by QA Representative.

5. A field panel is the unit area of geomembrane which is to be seamed in the field, i.e., a field panel is a roll or a portion of a roll cut in the field. Each field panel shall be given an "identification code" consistent with the layout plan. This code should be as simple and logical as possible.

6. Field panels are installed at the locations indicated by the layout plan. Each panel placement should be recorded immediately using the daily deployment report. Identification code, location and date shall be recorded. Form 2, or a comparable equivalent, shall be used by the Contractor to evaluate panel thickness and as a record of daily deployment. All panels that are folded shall be replaced by the Installer.

7. Field Seaming

a. The welding or seaming procedure consists of overlapping the two geomembrane sheets such that any water flowing across the seams would flow from the top panel to the underlying panel.

b. Longitudinal seams shall be oriented parallel to the slope, i.e., oriented along, not across the slope. In corners and odd shaped geometric locations, the number of field seams should be minimized.

c. Seams shall be aligned with the least possible number of wrinkles and "fishmouths". If a "fishmouth" or wrinkle is found, it shall be cut, removed and patched.

d. Details of each seam, including seamer, machine number, time, and temperature shall be recorded by the Contractor on the Pre-Weld and Geomembrane Seaming Record (Form 3).

8. Pre-Weld/Trial Weld

Pre-welds or trial welds shall be taken to verify the performance of welding equipment, seaming methods, and conditions. No seaming equipment or seamer shall be allowed to perform production welds until equipment and seamers have successfully completed trial weld(s). Pre-welds should be made in the same surroundings and environmental conditions as the production welds, i.e., in contact with the geotextile. Pre-welds shall be performed at the following frequency:

a. At all start-ups and prior to planned shutdowns.

b. Throughout the day as equipment requires start-up after a breakdown.

c. At a minimum of 4 hour intervals or as directed by QA Representative.

9. Samples should be at least 2 feet long and 1 foot wide with the seam centered lengthwise. (Typically the samples are made by the welder seaming two pieces of the geomembrane together). Ten, 1-inch wide strips should be cut from the trial weld.

10. Specimens should be quantitatively tested for peel adhesion and for bonded seam strength (shear) using a recently calibrated field tensiometer. A specimen is considered to pass when the following results are achieved. (For double-wedge welding, both welds shall be tested and both shall be required to pass in peel).

a. The break is film tearing bond (FTB).

b. The break is ductile.

c. The test results are consistent with test requirements established in paragraph 3.4(B) of Specification Section 02755.

11. Repeat the trial weld in its entirety when any of the trial weld samples fail in either peel and shear. When repeating trial welds fail, seaming apparatus and seamer shall not be used for production welding until deficiencies or conditions are corrected and two consecutive successful trial welds are achieved.

12. All trial welds shall be recorded by the Contractor on Form 3 (Pre-Weld and Geomembrane Seaming Record).

    a. Equipment - Extrusion fillet welders, extrusion flat wedge welders and hot wedge welders are the pieces of equipment approved for field seaming.

13. Non-Destructive Seam Testing

    Purpose of non-destructive testing is to check the continuity of the seam. The Contractor shall non-destructively test all field seams over their full length. All test equipment shall be furnished by the Contractor. Results of non-destructive testing shall be recorded on Form 4 non-destructive air pressure testing summary.

14. Destructive Seam Testing

    The purpose of destructive testing is to determine and evaluate seam integrity and assess long-term performance.

    The Contractor shall provide a minimum of one destructive test sample per 500 feet of seam length from a location specified by QA Representative; individual samples may be taken at greater or lesser intervals.

    Additional destructive tests may be taken in areas of contamination, offset welds, visible crystallinity or other potential cause of faulty welds, as determined by QA Representative.

All destructive seam samples shall be recorded by the Contractor on the Destructive Sample Record (Form 5). Information to be recorded includes date, sample number, seam number, machine number, seamer, date sent to lab and a summary of any field test performed.

a. Shear testing will be performed in accordance with ASTM D4437-NSF modified. This test involves peeling the sheets apart to observe how separation occurs. Results indicate whether or not the sheets are continuously and homogeneously connected through the seam.

b. Ten 1-inch wide replicate specimens shall be cut from the sample. Five specimens shall be tested for shear strength and five for peel adhesion. The test seam area will be considered acceptable if four of the five samples for each test fail outside of the seam area, provided all five samples must meet the following strength requirements:

SEAM PROPERTIES

TEST	TEST METHOD	FAILURE CRITERIA
Bonded Shear Strength (lb/in), min.	ASTM D 4437 - NSF Modified	120 (and Film Tear Bond) and >100% elongation
Seam Peel Adhesion (lb/in), min.	ASTM D 4437 - NSF Modified	100 (Fusion) and 90 (Fillet) Film Tear Bond and <30% Separation

Contractor shall document all actions taken in conjunction with destructive test failures.

15. Defects and Repairs

a. Identification - All seams and the entire geomembrane surface shall be observed by the Contractor for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Unacceptable panels shall be removed and replaced. Because light reflected by the geomembrane helps detect defects, the surface of the geomembrane shall be clean at the time of observation. Reflecting light will cause the surface of the geomembrane, at locations where there are imperfections, to appear white or light in color. The geomembrane surface shall be brushed, blown, or washed by the Installer if the amount of dust or mud inhibits observation, as determined by QA Representative.

b. Evaluation - Any suspect locations shall be non-destructively tested as appropriate in the presence of QA Representative. Each location that fails the non-destructive testing shall be marked by the Contractor, and repaired accordingly.

c. Repair Procedures - Any portion of the geomembrane exhibiting a flaw or failing a destructive or non-destructive test shall be repaired.

1. Defective seams shall be restarted/reseamed as described in these specifications.

2. Small holes shall be repaired by extrusion welding. If the hole is larger than 1/4-inch, it shall be patched.

3. Long lengths of failed seams shall be cap stripped.

4. Tears shall be repaired by patching. Where the tear is on a slope or an area of stress and has a sharp end it must be rounded by cutting prior to patching.

5. Blisters, large holes, undispersed raw materials, and contamination by foreign matter shall be repaired by large patches.

6. Surfaces of the geomembrane which are to be patched shall be abraded, cleaned and extrusion welded.

7. Folds shall be removed or patched.

Patches shall be round or oval in shape, made of the same geomembrane, and extended a minimum of 6 inches beyond the edge of defects. All patches shall be the same compound and thickness as the geomembrane specified. All patches shall have their top edge beveled with a grinder prior to placement on the geomembrane. Patches shall be applied using approved methods only.

All surfaces must be clean and dry at the time of repairs. All seaming equipment used in repairs must be approved by QA Representative and Contractor. All repair procedures, materials, and techniques shall be approved in advance of the specific repairs by QA Representative and Contractor.

Form 6 (FML Repair Locations) shall be completed by the Contractor to document repairs.

a. Restart/Reseaming Procedures - The welding process shall restart by grinding the existing seam and rewelding a new seam. Welding shall commence where the grinding started and must overlap the previous seam by at least two inches. Reseaming over an existing seam without regrinding shall not be permitted. Reseaming must be approved by QA Representative.

b. Verification of Repairs - Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved. QA Representative shall take additional destructive seam samples, as necessary, for long lengths of cap stripped seam.

c. Recording of results: daily documentation of all non-destructive and destructive tests shall be prepared by QA Representative. This documentation shall identify all seams that initially fail destructive testing and indicate evidence that these seams were repaired and successfully retested. Documentation shall identify all patch, bead or cap strip locations and indicate that repairs were made and successfully tested.

FORM 1

MATERIAL

DELIVERY REPORT

PROJECT NAME:
PROJECT NUMBER:
LOCATION:
DATE:
MATERIAL TYPE:

ROLL NO.	BATCH NO.	RESIN TYPE	DESCRIPTION OF DAMAGE

COMMENTS:

OFF-LOADING PROCEDURES:

MATERIAL STORAGE:

FORM 2
GEOMEMBRANE PANEL DEPLOYMENT LOG

PROJECT NAME:____________________ DATE DEPLOYED:
PROJECT NUMBER:__________________ TEMP: Max:________F; Min:________F
LOCATION:________________________ WIND:________________ mph N S E W

ALL MEASURED IN MILS

					SEAM NO.:									
					SEAM NO.:									

SUB-GRADE ACCEPTED FOR AREA BENEATH PANEL NUMBER:
__________ Yes __________ No

REMEDIAL WORK REQUIRED:
__________ Yes __________ No

	TYPE OF WORK REQUIRED:	

REMEDIAL WORK COMPLETED AND AREA ACCEPTED:
__________ Yes __________ No

COMMENTS:	

PANEL NUMBER:__________________
PANEL LENGTH:__________________
ROLL NUMBER:__________________

FORM 3

PRE-WELD AND GEOMEMBRANE SEAMING RECORD

PROJECT NAME:
PROJECT NUMBER:
LOCATION:
DATE:
CQA MONITOR:

WELDING MACHINE NUMBER:__________ WELDER'S NAME:

Pre-weld Seam #	Time am/pm	Temp.	Temperature of		Results		Pass/ Fail*
			Welder	Extrudate	Peel	Shear	

COMMENTS:

NOTE: USE ONLY ONE FORM PER WELDER.

* PASS OR FAIL RESULTS ARE FOR PRE-WELDS ONLY, TEST RESULTS FOR SEAMS ARE DOCUMENTED ON FORMS 4 AND 5.

FORM 4

NON-DESTRUCTIVE AIR PRESSURE SEAM TESTING

PROJECT NAME:
PROJECT NUMBER:
LOCATION:

SEAM NUMBER	CQA	TIME	PSI	DATE	TIME	PSI	PASS/ FAIL *

* REPAIRS OF FAILED SEAMS ARE DOCUMENTED ON FORM 5

** EXTRUSION WELDED

FORM 5

DESTRUCTIVE SAMPLE RECORD

PROJECT NAME:
PROJECT NUMBER:
LOCATION:

DATE	DS NO.	SEAM NO.	MACH NO.	OPER NAME	FIELD TEST		DATE TO LAB PKG SLIP NO. FEDEX/UPS
					PEEL	SHEAR	

FORM 6

FML REPAIR FORM

REPAIR DESIGNATION	DATE DAMAGE OBSERVED	DATE REPAIR CONDUCTED	SIZE	LOCATION OF REPAIR	REPAIRED TEST DATE	RESULT

END OF SECTION

SECTION 02831

FENCING

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section shall include the installation of Site security fencing to replace fencing removed during the Work and the installation of security fence along the RMC property boundary adjacent to the CSX right-of-way. The Contractor shall provide all expertise, supervision, labor, materials, and equipment necessary to complete the work as detailed on the Drawings and as specified herein.

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work
B. Section 01050 - Field Engineering
C. Section 01300 - Submittals
D. Section 01545 - Health and Safety
E. Section 02110 - Site Clearing

1.3 REFERENCES

CLFMI - Chain Link Fence Manufacturer's Institute. Voluntary Standards for Chain Link Fence Installation

1.4 SUBMITTALS

The Contractor shall submit manufacturer's installation instructions and material specifications including standard details to the QA Representative for review and approval prior to any fence installation. The Contractor shall also submit the installation subcontractor's qualifications and proof of insurance.

PART 2: PRODUCTS

2.1 SECURITY FENCING

A. Fabric

The fabric of the security fencing shall consist of No. 9 gauge (0.148 inch) finished steel wires, 2-inch mesh with top and bottom salvages twisted and barbed. The fabric height shall be 60 inches. 3-strand barbed wire shall be provided and installed at the top of the security fence.

B. End, Corner, and Pull Posts

Posts shall be 2.375-inch OD steel pipe weighing 3.65 pounds per lineal foot, or 3.5-inch by 3.5-inch roll-formed sections, 4.85 pounds per lineal foot.

C. Line Posts

Line posts shall be spaced 10 feet on center maximum, unless otherwise indicated. Posts shall be 2.375-inch OD steel pipe, 3.65 pounds per lineal foot.

D. Top Rail

The top rail shall be manufacturer's longest length with expansion-type couplings, approximately six inches long, for each joint. The Contractor shall provide means for attaching the top rail securely to each corner, pull, and end post. The top rail shall be 1.66-inch OD pipe, 2.27 pounds per lineal foot, or 1.625-inch by 1.25-inch roll-formed sections, 1.35 pounds per lineal foot.

E. Tension Wire

The tension wire shall be 7 gage, coated coil spring wire, metal type and finish to match fabric. Tension wire shall be located at bottom of fabric only.

F. Post Tops

Post tops shall be weather-tight closure cap (for tubular posts), one cap for each post. Caps shall be furnished with openings to permit passage of top rail and with stands for the installation of the barbed wire.

G. Stretcher Bar

Stretcher bars shall be one piece lengths equal to the full height of fabric, with a minimum cross-section of 13/16-inch by ¾-inch. One stretcher bar shall be provided for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into post.

H. Stretcher Bar Bands

The Contractor shall provide stretcher bar bands which shall be spaced at not more than 15 inches on-center (o.c.), to secure stretcher bars to end, corner, pull, and gate posts.

I. Wire Ties

For tying fabric to line posts, the Contractor shall use wire ties spaced one foot o.c. For tying fabric to rails and braces, the Contractor shall use wire ties spaced two feet o.c. For tying fabric to tension wire, the Contractor shall use hog rings spaced 2 feet o.c.

Manufacturer's standard tying or connection procedures shall be accepted if of equal strength and durability.

J. Galvanized Finish

The fabric shall be galvanized with not less than 2.0 ounce zinc per square foot of surface. The framework shall be galvanized steel with not less than 1.8 ounce zinc per square foot of surface. Hardware and accessories shall be galvanized.

K. Concrete

Concrete for post anchorage shall obtain a minimum 28-day compressive strength of 2,500 pounds per square inch (psi) using at least four sacks of cement per cubic yard, contain 1-inch maximum size aggregate.

2.3 WARNING SIGNS

Warning signs shall be at least 2 ft by 2 ft and shall be constructed of durable weather resistant material with white background and red lettering. Warning signs shall be printed in English and Spanish and shall read as follows:

WARNING! (2")
NO TRESPASSING (2")
DO NOT DISTURB SOIL (2")
FOR INFORMATION (1")
(610) 921-4054 (1")

PART 3: EXECUTION

3.1 INSTALLATION

A. General

The Contractor's Surveyor shall locate property boundary along common property line between RMC and CSX and stake alignment of proposed fence to coincide with property line. Contractor shall complete necessary clear and grading along the fence alignment before beginning installation, unless otherwise permitted by the QA Representative. Replacement fence shall coincide with original alignment. The Contractor shall install the fence fabric and related hardware in compliance with this Specification and manufacturer's instructions. Installation shall be coordinated with the QA Representative.

B. Security Fence Posts

Excavation for the posts shall be to the depth required by local building code or at least 30 inches below finished grade, whichever is greater. Posts shall be placed and aligned in the center of the holes, six inches above the bottom and set in concrete. Vertical and top alignment should be checked for each post or sleeve and held in place during placement and finishing. Location of existing utilities along the path of the fence shall be located and marked in the field prior to installation and any conflicts identified in writing to the QA Representative.

C. Warning Signs

Warning signs identified in Section 2.3 shall be installed at sections of fence along Big Four Road, South Arlington Avenue and the CSX right-of-way, such that the center of the sign is 56 inches above ground surface and shall be capable of being seen at least 75 feet away. A sign shall be installed on the interior side of fencing every 100 linear feet. Signs shall be installed facing outward.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Fencing shall be measured as lineal feet in place. Signs shall be measured as number installed.

Grading, clearing and grubbing required for erection of the fence shall be considered incidental to the work.

4.2 PAYMENT

Security fencing placed in accordance with the Drawings and Specifications shall be paid according to the approved unit price schedule for the length in place. Signs placed in accordance with the Drawings and Specifications shall be paid for at the approved unit price schedule for the number in place.

PAY ITEM	PAY UNIT
Security Fence	Lineal Foot
Warning Signs	Each

SECTION 02936

SITE RESTORATION

PART 1: GENERAL

1.1 DESCRIPTION

The work covered under this section shall include stabilizing those areas disturbed directly or indirectly by the corrective measures construction including restoring excavation areas in the drainage ditches along South Arlington Avenue with sod, restoring the drainage ditches along the CSX railroad right-of-way and on-site with aggregate, restoring the excavation area south of the Citizens Gas fence line with turf, and restoring the on-site areas with either crushed aggregate or turf as designated on Sheet 9 of the design drawings including turf establishment on containment cell.

The Contractor shall provide all labor, materials and equipment to prepare subgrade to receive the proposed restoration. Within areas proposed for sod or turf (grass from seed) the Contractor shall secure and import topsoil, spread topsoil, fertilize, mulch, seed, water, place sod and maintain seeded and sodded areas designated until acceptance in accordance with the Contract Documents and as directed by the QA Representative. Restoration of areas with aggregate will include installing a geotextile filter fabric (where designated), providing and placing aggregate, protecting stabilized areas until final acceptance.

1.2 RELATED SECTIONS

A. Section 01050 – Field Engineering

B. Section 01351 - Health and Safety Plan Requirements

C. Section 02100 - Site Preparation

D. Section 02110 - Site Clearing and Grubbing

E. Section 02115 - Erosion and Sediment Control Measures

F. Section 02150 – Demolition of Remnant Structures

G. Section 02210 – Earthwork

H. Section 02715 – Water Management During Construction

I. Section 02720 – Post-Remediation Stormwater Management

J. Section 02831 - Fencing

1.4 SUBMITTALS

The following submittals are required as part of the site restoration work:

- Contractor shall submit topsoil and sod source names, location and previous land use, results of topsoil analyses, a certification that the topsoil and sod are clean and recommendations for fertilizer and lime.

- Certificates from lime and fertilizer vendors including pertinent material properties.

- Certificates from seed vendors for proposed seed mixtures including botanical and common names and proportions of seeds, purity content expressed as percentage, and germination.

- Suppliers recommendations for installation and maintenance of turf and sod including cutting method and recommended grass height, fertilizer frequency and rates, and recommendations for watering/soil moisture. Contractor shall highlight where supplier's recommendations vary from these specifications and request QA Representative approval for deviation from this specification.

- Contractor shall submit name and location of proposed quarry for aggregate including IDEM permit number and certification that aggregate source is not contaminated.

- Contractor shall submit manufacturer's material property and installation information, labels and delivery tickets for tackifier, erosion control mat, and geotextile.

1.5 QUALITY ASSURANCE

Quality Assurance shall be performed in accordance with the CQAP. The QA Representative shall ensure that work is completed in accordance with the Contract Documents.

PART 2: PRODUCTS

2.1 TOPSOIL

Topsoil shall be friable and loamy and classified as loam, silt loam, sandy clay loam, or clay loam capable of supporting capable of supporting good vegetative growth. Topsoil shall be free from subsoil, slag, clay, stones, lumps, live plants, roots, sticks, noxious weeds, mine spoils, and foreign matter prior to placement.

Soil analyses shall be conducted at least once for every 1,000 cubic yards of topsoil placed. Soil analyses shall consist of tests for organic content, nutrients, and pH conducted by an approved agricultural laboratory. Geotechnical testing shall consist of classification in accordance with the Unified Classification System (ASTM D2487). The Contractor shall incorporate fertilization and liming recommendations developed from the soils analyses for the topsoil. Recommendations shall include at a minimum: application rates, fertilizer type and quality, and lime type and quality specific to areas being restored with sod and areas being restored with turf. Topsoil shall have an organic carbon content greater than 2.5 percent.

Imported soil fill shall be analyzed for TAL Metals/TCL VOCs and SVOC compounds and shall be less than IDEM RISC Default Residential Standards for Direct Contact and Soil to Groundwater, whichever is more stringent. Analytical testing shall be conducted once for each borrow source, unless additional testing is requested by the QA Representative. Copies of the bills of lading for each load of imported material shall be submitted with the Contractor's Daily Reports to document the borrow source.

The submittal for each topsoil source shall include the source name, location, the prior use of the source, and a statement from the supplier that the material is not contaminated.

2.2 FERTILIZER

Fertilizer shall be commercial grade, free flowing, slow release fertilizer with 50% of the elements derived from organic sources, uniform in composition and shall conform to applicable local, state and federal regulations. Fertilizer rates and proportions shall meet the recommendations developed by topsoil analysis as required to eliminate any deficiencies in the topsoil to the following proportions: Nitrogen 20%, phosphoric acid 10%, soluble potash 10%.

2.3 SEED MIXTURE

The temporary seed mixture shall be annual rye grass or alternate proposed by the Contractor and approved by the QA Representative applied at a rate of 20 lb per acre.

The permanent seed mixture for the area south of the Citizens Gas fence, the cap and other disturbed areas designated for turf establishment shall be composed of the following species. Mix ratios may be altered based on availability of species:

- 50% Kentucky Blue Grass
- 20% Creeping Red Fescue
- 20% Integra Perennial Rye
- 10% Clover

Seed shall have a minimum pure seed content of 98% with a minimum germination of 85%. Seed shall be applied at a rate of 150 lb to 200 lbs per acre. Seed shall be furnished in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging, and location of packaging. Damaged packages shall not be accepted. Seed germination shall have been tested within six months of the planting date. No seed shall be accepted with a germination test date more than six months old unless retested.

2.4 MULCH AND TACKIFIER

Mulch shall consist of dry oat or wheat straw free from weeds, foreign matter undesirable to plant life. Straw mulch shall not be chopped or finely broken (except for hydroseeding). Mulch shall be applied in combination with seed, tackifier and water using a hydraulic seeder. Mulch rate shall be 1,000 lbs/acre. Tackifier shall be a non-toxic/non-asphaltic emulsion and consist of natural vegetable gum blended with jelling and hardening agents, approved by the QA Representative. Application rate shall be 220 lbs per acre unless otherwise recommended by the manufacturer. Water shall be utilized at a rate of 4,500 gallons per acre during hydroseeding.

2.5 TURF REINFORCEMENT

Synthetic erosion control mat shall be used on the containment cell. Synthetic erosion control mat shall be similar to Tensar Mat 400, or approved equivalent, and shall have a minimum unit weight of 12 ounces per square yard.

Turf reinforcement used for all turf areas (excluding the containment cell) shall be a biodegradable fiber mat similar to Curlex NetFree or approved equivalent. shall be used for all remaining turf. The material shall not have polypropylene netting.

2.6 SOD

Sod will be used to establish turf within designated stormwater swales and basins. The sod grass type shall be similar to the seed mixture specified in 2.3. Sod shall be free of weeds and undesirable coarse weedy grasses. Sod shall be machine cut at a uniform soil thickness of 1- inch (2.5 cm), plus or minus 1/4 inch (0.6 cm), at the time of cutting. This thickness shall exclude shoot growth and thatch. Pieces of sod shall be cut to the suppliers standard width and length, with a maximum allowable deviation in any dimension of 5%. Torn or uneven pads will not be acceptable. Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended from a firm grasp on one end of the section. Sod shall not be cut or laid in excessively wet or dry weather. Sod shall be harvested, delivered, and installed within a period of 36 hours.

2.7 WATER

Water utilized for hydroseeding and maintenance watering shall be clean, fresh water. Watering to be performed on restored turf and sod areas not owned by RMC shall be obtained from the local public water/fire service. The Contractor will be permitted to utilize water from within the proposed stormwater management basin for watering on the RMC property when approved by the QA Representative and the Contractor can assure that the water can be removed without disturbing sediment. The Contractor will not be permitted to utilize treated water from the water treatment system.

2.8 AGGREGATE

Coarse aggregate shall be utilized to stabilize excavation areas within the drainage ditches along the CSX right-of-way (including portions on Citizens Gas property) drainage ditches on the RMC property, and areas designated for surface stabilization with coarse aggregate. The types of aggregate shall be as follows:

2.8.1 Drainage Ditch Aggregate – Aggregate utilized to stabilize drainage ditches shall be imported from an off-site quarry and be a hard durable angular stone meeting the gradation requirements for AASHTO #1 Stone. Recycled concrete may not be utilized as drainage ditch aggregate.

2.8.2 Off-Site Surface Stone Aggregate – Aggregate utilized for surface stone aggregate on property not owned by RMC shall be a hard durable angular stone imported from an off-site quarry and meeting the gradation of an AASHTO #3 stone.

2.8.3 On-Site Surface Stone Aggregate – To the maximum extent possible the contractor shall utilize crushed/recycled concrete derived from on-site for use as on-site surface stone aggregate. Recycled concrete will be derived from the demolition and sizing of concrete floors and pavement designated for removal to facilitate proposed soil removal to the extent that the existing concrete can be removed without inclusion of underlying contaminated soils with the removed concrete, except for the degraded portions of the concrete floor in the former Material Storage Building and Battery Breaker as identified by the QA Representative that must be placed in the containment cell. Removal of concrete pavement and floor slabs, necessary to facilitate final grading will also be sized and utilized as on-site surface stone aggregate. Crushed concrete designated for use as on-site surface stone aggregate must be crushed to a maximum size of 4-inches, have reinforcing steel removed and then be staged in stockpiles and tested at least once every 500 cubic yards for antimony, arsenic, cadmium, lead and selenium and proven to have concentrations below the standards established for HWMU closure. Material failing this characterization standard shall be placed in the containment cell. Additional material required to complete on-site surface stone stabilization shall meet the requirements for off-site surface stone described above.

2.9 GEOTEXTILE

Geotextile placed beneath the aggregate in areas of drainage ditch restoration shall be a non-woven geotextile filter fabric material possessing a minimum grab strength of 200 lbs/in and minimum puncture strength of 90 lbs.

PART 3: EXECUTION

3.1 GENERAL

On-site and off-site drainage ditches shall be restored with aggregate. Off-site drainage ditches along South Arlington Avenue and the lawn area south of the Citizens Gas fence shall be restored with sod. Disturbed areas (besides the drainage ditch along the driveway) within the RMC property shall be restored with turf (topsoil, seed, mulch, erosion control mat and fertilizer) or on-site surface stone.

3.2 DELIVERY, STORAGE AND HANDING

3.2.1 Seed

Seed shall be delivered and stored in sealed standard containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging and location of packaging. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. Damaged packages are not acceptable.

3.2.2 Fertilizer

Fertilizer shall be delivered and stored in waterproof bags showing weight, chemical analysis, and name of manufacturer.

3.2.3 Erosion Control Mat

Erosion control mat shall be stored in accordance with Manufacturer's recommendations. Damaged rolls are not acceptable.

3.3 TOPSOIL PLACEMENT

Topsoil shall be graded in accordance with the design drawings and to the satisfaction of the QA Representative. Underlying soil shall be properly graded and loosened to a depth of 2 inches before placing the topsoil. Stones and other foreign material 2 inches or larger in any dimension shall be removed. Unsuitable or surplus material shall be removed and satisfactorily disposed of by the Contractor.

Topsoil shall be placed on prepared areas and, unless otherwise indicated, spread and compacted to a 6-inch uniform depth +/- 1.5 inches. Compaction shall be with a roller weighing not over 120 pounds per foot width of roller. Topsoil shall not be placed in a wet or frozen condition or on wet or frozen subgrade.

3.4 TURF REINFORCEMENT

Turf reinforcement shall be installed in the topsoil in accordance with Manufacturer's instructions. Turf reinforcement shall secured using biodegradable stakes. Metal pins will not be permitted.

3.5 SEED BED PREPARATION

Previously placed materials shall be protected by the Contractor during seeding. Foreign materials, plants, roots, stones, and debris shall removed from the area being seeded.

The Contractor shall cultivate the ground surface to a depth of 3 inches until the soil is uniform in texture and suitable for seeding. Discing, raking, blading, or other approved methods shall be used to prepare the soil for seeding. Areas inaccessible to mechanized equipment shall be cultivated by hand. The surface of the seed bed shall conform to the established finished grades.

3.6 FERTILIZER

Fertilizer shall be applied at the rate recommended by the results of the topsoil analyses. Application shall be performed with a drill or broadcast spreader or hydraulically as a seed fertilizer slurry.

3.7 TEMPORARY SEED APPLICATION

Temporary seed shall be applied immediately at the rate identified in Section 2.3 if the area will be exposed 14 days or more. After seedbed preparation, the Contractor shall apply the specified seed mixture, fertilizer and mulch. Seed shall be sown uniformly by means of rotary seeder, cyclone seeder, drill, cultipacker seeder or hydroseeder.

3.8 PERMANENT SEED APPLICATION

After seed bed preparation, the Contractor shall apply the seed mixture in Section 2.3 within 14 days of grading completion. Seed shall be sown uniformly by means of a rotary seeder, hydraulic equipment, or other approved technique. The preferred seed application period shall be April through July; however, seed may be applied as late as September or early October. All areas disturbed by remedial activities shall be permanently seeded using specified seed types and application rates. Seeding shall be performed in accordance with the manufacturer's recommendations.

3.9 SOD INSTALLATION

Prior to laying sod, the soil surface shall be clear of trash, debris, roots, branches, stones and clods in excess of 2 inches (5 cm) in length or diameter. Sod shall not be applied to gravel or other non-soil surfaces. Any irregularities in soil surface resulting from topsoil or other operations shall be filled or leveled in order to prevent the formation or depressions or water pockets.

Areas to be sodded will be watered with a minimum of 1/2-inch (13 mm) of water unless recent rains have provided equivalent moisture. The first row of sod shall be laid in a straight line with subsequent rows placed parallel to and butting tightly against one another. Lateral joints shall be staggered to promote uniform growth and strength. Care shall be exercised to insure that sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would cause drying of the roots. Sod shall be laid with staggered joints and be secured by pegging or other approved methods. Sod shall be installed with the length perpendicular to the slope. Begin laying sod at the bottom of the slope and work uphill. As sodding of clearly defined areas is completed, sod shall be rolled or tamped to provide firm contact between roots and soil. Turf reinforcement, or other netting may be pegged over sod for extra protection in critical areas. Sod shall be installed in the remediated areas along South Arlington Avenue. Turf shall be used for vegetation in all other areas.

3.10 MULCHING

Mulch material shall be applied by the Contractor following seeding. Mulch may also be applied during hydroseeding. Mulch shall be spread uniformly over the seeded areas at a rate of 1.0 tons/acre (0.5 tons/acre if hydroseeding). The mulch shall be applied to produce a loose layer 0.75 to 1 inch deep. Mulches of hay or straw shall be tied down with liquid mulch binder at a rate of 200 to 250 gallons per acre, or synthetic binder applied in accordance with the manufacturers specifications. Binder applied through hydro-seeding shall be applied at 220 gallons per acre

3.11 WATERING

The Contractor shall apply water as needed to maintain a continuously moist seed bed to ensure germination. Sufficient water shall be applied in the form of a fine spray to moisten the soil to a depth of three (3) inches. Surface water from creeks and ditches may not be used for this purpose. Watering shall be performed so as not to disturb seed or anchor mulch. Watering may not be required, depending on the weather conditions.

For sodded areas, after rolling sod shall be irrigated to a depth sufficient that the underside of the sod pad and the soil 4 inches (10 cm) below the sod is thoroughly wet. During the first week, in the absence of adequate rainfall, watering shall be performed as often as necessary to maintain moist soil to a depth of at least 4 inches (10 cm).

3.12 PROTECTION

The Contractor shall protect restored areas against traffic and damage by erecting barricades and warning signs.

3.13 REPAIR AND MAINTENANCE

The turf and sod areas shall be subject to scheduled inspections by the RMC 30 days, 90 days, and one year after completion of the contract work. RMC may also perform more frequent inspections as deemed necessary based on factors such as weather and success of vegetation. If, during the course of these inspections, any portion(s) of the seeded areas are found to be unsatisfactory (areas of erosion, thin vegetative coverage or no coverage) to RMC, the areas shall be repaired and re-seeded by the Contractor as originally specified, at no additional expense to RMC.

The Contractor shall guarantee at least 90 percent surface area coverage of live, growing species from the seed mix applied for a period of one (1) year following the date of completion of work, with the largest individual surface area not meeting the 90 percent coverage requirement not to exceed 100 square feet. Areas not fulfilling this requirement shall be prepared and re-seeded at the expense of the Contractor. Areas disturbed by re-seeding shall also be re-seeded at the Contractor's expense using the seed mix specified in this specification, unless alternate seed mix is approved by the QA Representative.

The following maintenance shall be completed to establish and maintain the permanent vegetative cover:

1. Apply sufficient water to ensure uniform seed germination. The water shall be applied slowly to avoid puddling and crusting of the topsoil.

2. Add topsoil where necessary, including areas affected by erosion, to maintain a uniform surface at the design grade.

3. Reseed damaged areas showing root growth failure, deterioration, bare or thin spots, and eroded areas and apply sufficient water to ensure uniform germination.

4. Perform mowing and fertilization at 3 month intervals during the growing season including a final mowing and fertilization within 2 weeks of the final one year inspection. For sodded areas mowing shall not be attempted until the sod is firmly rooted (typically 2-3 weeks).

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Topsoil, of the specified 6-inch depth, shall be measured by area in square yards. Topsoil spread to a greater depth than specified or directed shall not be paid for but shall be considered as having been included as part of the contract unit price bid for topsoil. Turf reinforcement shall be measured by area in square yards.

Chemical fertilizer nutrient and lime will not be measured and shall be included in the unit price for seeding. Seeding shall be measured in place by area in acres. Straw mulch and binder shall be measured in place by area in acres. Watering, maintenance, repairs, mowing, re-seeding, and re-sodding shall not be measured and shall be included in the unit prices for seeding or sodding.

4.2 PAYMENT

Turf establishment items shall be paid for by RMC at the contract prices according to the following contract item units:

PAY ITEM	PAY UNIT
Topsoil	Square yard
Turf Reinforcement	Square yard
Turf Reinforcement (Net Free)	Square yard
Seeding, Mulching, Fertilizing	Acre
Sod Installation	Square Yard
Stone Drainage Ditches	Lineal Foot

Prices shall include, but will not be limited to, all labor, materials, equipment and expertise for preparation of subgrade to receive topsoil, spreading of the topsoil, installation of erosion mat, seeding or sodding, fertilizing, watering and maintaining seeded areas until acceptance in accordance with the Specifications, Drawings, or as directed by the QA Representative.

All work associated with furnishing and hauling material will not be paid separately but shall be included in the work required, and as approved by the QA Representative.

All work associated with topsoil sample analysis will not be paid separately but shall be considered included in other items of the work required for turf establishment.

Topsoil, sod, seed and mulch that washes out or blows away after it has been constructed and approved by the QA Representative for partial payment, shall be replaced by the Contractor at the Contractor's expense.

No additional payment will be made for removing approved material which is rendered unsuitable after placement or replacement; for removal, hauling, disposal and replacement of objectionable material; nor for any material placed outside of the lines and grades as shown on the Drawings or approved by the QA Representative.

END OF SECTION

SECTION 02999

DUST CONTROL AND AIR MONITORING

PART 1: GENERAL

1.1 DESCRIPTION

The work covered by this section shall include, but not be limited to furnishing, installing, and maintaining dust controls and air monitoring. The Contractor shall be responsible for all controls necessary to prevent generation of dust. The quantity and type of dust control measures may be increased or decreased based upon actual conditions which occur during the work. Such variations in quantity shall not be considered as alterations in the details of construction or a change in the character of the work.

The Contractor shall be responsible for both Real-Time Air Monitoring and Time-Integrated Air Sampling as follows:

A. The Contractor shall provide, install, and maintain three (3) ambient air monitoring stations at the Site. The three stations shall be located as shown Sheet 4 of the design drawings. The station locations shall be placed upon platform raised 1.5 to 2 meeters above the surrounding grade.

B. The Contractor shall ensure that each station is equipped to monitor for total suspended particulates (TSP) and total lead.

C. The Contractor shall be responsible for the collection and analysis of all air monitoring samples and for the delivery of those samples to the analytical laboratory.

D. The Contractor shall maintain sample logs and quality control reports for submission to the RMC on an ongoing basis during the project.

E. The Contractor shall be responsible for evaluating the results of air sampling and for informing the QA Representative and RMC of any measures including additional dust control measures which are necessary based upon those results. All results shall be submitted to the QA Representative.

F. The Contractor shall be responsible for Real-Time Air Monitoring of construction activities using a direct reading aerosol monitor.

The Contractor shall be responsible for providing electrical power for the operation of the air monitoring stations and for protecting the stations from damage and theft.

1.2 RELATED SECTIONS

A. Section 01351 - Health and Safety Plan Requirements

B. Section 02100 - Site Preparation

C. Section 02110 - Site Clearing/Grubbing

D. Section 02150 – Demolition of Remnant Structures

E. Section 02209 – Excavation/Handling/Placement

F. Section 02210 – Earthwork

G. Section 02936 – Site Restoration

1.3 DEFINITIONS

CQAP - Construction Quality Assurance Plan
TSP - Total Suspended Particulates

1.4 QUALITY ASSURANCE

Construction quality assurance shall be performed in accordance with the CQAP.

1.5 REFERENCES

40 CFR Part 50 Appendix B - Reference Method for the determination of suspended particulate matter in the atmosphere.

USEPA SW-846 - Test Methods for evaluating solid waste - physical/chemical methods.

1.6 SUBMITTALS AND QUALIFICATIONS

The Contractor who performs the air monitoring functions described in this section shall be experienced in the field of air monitoring at various sites. The Contractor shall possess a staff of chemists, industrial hygienists or environmental scientists who are capable of assessing the results of air monitoring and advising the RMC on matters related to the results of analysis.

The laboratory that will provide analytical testing of air monitoring samples shall be experienced in the analysis of such samples and shall be approved by the QA Representative.

PART 2: PRODUCTS

2.1 TIME-INTEGRATED AIR SAMPLING

2.1.1 Station Construction Materials

In constructing the air monitoring stations, the Contractor shall employ materials designed to be weather resistant, such as pressure treated lumber or steel. Construction materials shall be of adequate thickness and strength to support all possible sampling equipment and all personnel who may be involved with collection of samples or maintenance of equipment.

2.1.2 High Volume Air Sampling Stations

The Contractor shall employ air samplers of the following or similar manufacture:

A. Three (3) high volume samplers for the collection of TSP and total lead. The samplers shall be General Metal Works (GMW) Model 2310 samplers or approved alternate.

2.1.3 Air Sampling Media

Samples to be tested for lead and TSP shall be collected on USEPA-approved borosilicate glass fiber filters.

2.2 REAL-TIME AIR MONITORING

The Contractor shall monitor for TSP using a direct reading aerosol monitor.

2.3 WIND DATA

Contractor shall provide and operate an on-site meteorological station capable of measuring and recording wind direction and speed. Results of the wind measurements will be submitted with the corresponding results.

2.4 DUST CONTROL MEASURES

Dust control measures shall include potable water, stockpile covers, mulch, or spray adhesives. Decontamination water shall be used for dust control only in contaminated areas. Mulch shall meet the requirements of Section 02936. The use of spray adhesives must specifically be approved by the QA Representative through the submittal process prior to on-site use.

PART 3: EXECUTION

3.1 RELATIONSHIP TO WORKER HEALTH AND SAFETY PROGRAM

Ambient air monitoring as described herein shall not be considered a substitute for air monitoring activities related to the health and safety of site workers.

3.2 DUST CONTROL

Dust control shall be conducted throughout the Site during all phases of work to prevent the presence of visible dust. The condition of no visible dust shall be maintained at all times. The QA Representative shall have the authority to stop work at any time if visible dust is present or if performance standards are exceeded. Work may not proceed until dust control measures are implemented to the satisfaction of the QA Representative at no additional cost to the RMC for either the additional dust control or the stoppage of work. Dust control measures shall be applied periodically throughout each work day throughout the Site. Dust control measures shall be applied to disturbed contaminated areas, including excavations and placed waste, at the end of each work day. Dust control may be conducted by sprinkling with potable water in non-contaminated areas, until the surface is wet. Dust control shall be conducted by the Contractor to the satisfaction of QA Representative at no additional cost to the RMC.

3.3 TIME-INTEGRATED AIR SAMPLING

3.3.1 Construction of Monitoring Stations

The Contractor shall provide and install high volume particulate samplers mounted on a stable base, 1.0 to 1.5 meters above the ground surface. The Contractor shall ensure that the stations are supplied with electric current.

3.3.2 Fixed Ambient Air Monitoring for Total Lead

Total lead sampling shall be performed for a minimum of three (3) days prior to commencement of work, in order to establish baseline conditions. Thereafter, total lead sampling shall be performed daily for each work phase with potential for release lead impacted of dust. Work phases that have a potential for significant release of dust include demolition, clearing/grubbing, soil/waste/sediment excavation, waste placement and restoration grading. Samples shall be collected with high volume air samplers for a 24-hour period.

Analysis of the high volume samples will be performed on a rush basis (3 to 5 days). If analytical results from the first three days of sampling of each phase of work are below one-half the target levels, then the sampling and analysis frequency will be reduced to once per week, and samples collected after 3 days but prior to receiving initial data do not need to be analyzed. If the results exceed one-half the action levels, then sampling and analysis will continue on a daily basis. Any discrepancy on the need to collect air monitoring samples for a given day or activity shall be resolved by the QA Representative.

The target level for lead in dust is 0.15 $\mu g/m^3$ based on a 90 day rolling average as calculated for each TSP monitoring location. In addition, the maximum average weekly (based on 7-days) target level will be 0.5 $\mu g/m^3$. The 90 day rolling average and weekly averages will be calculated by the QA Representative using the results of the laboratory sampling

If the total lead level in any of the daily samples exceeds 0.5 $\mu g/m^3$, the Contractor shall immediately take the necessary measures to reduce lead level. The Contractor is responsible for ensuring that target levels are achieved.

3.3.3 Sampling Equipment and Media

Samples for analysis of TSP and total lead will be collected with high volume sampling stations using bososilicate glass fiber filters.

3.3.4 Calibration Procedures and Frequency

The sampling equipment shall be calibrated at the beginning of the project and weekly thereafter. High volume samplers shall be calibrated according to the manufacturer's recommendations.

3.3.5 Analysis Method

Preparation and analysis of samples for total lead analysis will be conducted in accordance with USEPA/RCRA SW-846 Methods for Inductive Coupled Plasma Atomic Emission Spectroscopy (Method 6010).

Preparation and analysis for determination of TSP will be performed gravimetrically using the USEPA Reference Method in 40 CFR 50, Appendix B.

3.3.6 Sample Custody

All samples shall be handled as described in the CQAP. All TSP filters shall be folded in half and then in half again and placed individually in Ziploc bags.

A complete chain-of-custody form shall be maintained for each set of samples collected from the site. Transportation and transfer of the samples shall comply with USEPA recommended chain-of-custody protocols. Field notes shall be collected at the time of sample collection and will include any unusual conditions associated with the sample or sampling equipment.

3.4 REAL-TIME PERIMETER AIR MONITORING

Real-time air monitoring at the Site perimeter and work zone perimeter shall be performed during all phases of the work with potential for significant release of dust. Real-time monitoring at the work zone and Site perimeters shall be performed during decontamination, demolition, soil excavation, backfill, waste placement, cap installation and any other dust generating activities as determined by the QA Representative.

The QA Representative will calculate a target airborne particulate concentration (i.e., a trigger level) for down wind of the work zone based on the National Ambient Air Quality Standard (NAAQS) for lead ($0.15\mu g/m^3$). This calculation will be performed by back calculating an allowable total particulate levels based on an average lead concentrations within the active work zone.

The Contractor shall monitor for TSP at a minimum of six locations at the perimeter of the Site every 2 hours during each work activity listed above, and shall monitor the work zone perimeter hourly during each work activity.

If real-time TSP monitoring results at the Site perimeter exceeds the trigger level, the Contractor shall stop work and initiate additional dust control measures. If real-time TSP monitoring results at the work zone perimeter exceeds the trigger level, the Contractor shall initiate additional dust control measures.

3.5 FIELD RECORDS

A logbook shall be maintained by operating personnel and kept up to date at all times. The logbook shall include observations relevant to operation of the air monitoring network and shall include the results of all real-time air monitoring. This book shall include all operating days and times, calibrations, problems, and corrective actions taken, maintenance, and results. All air monitoring results shall be provided to the QA Representative with the daily QC report.

The Contractor shall provide instrumentation at the Site to determine the wind speed and wind direction. Wind speed and wind direction shall be obtained continuously. In addition, the Contractor shall obtain temperature and precipitation data on a daily basis from the nearest National Weather Service Station. All meteorological measurements will be included in the air monitoring report.

3.6 TERMINATION OF AIR MONITORING

The Contractor shall not terminate monitoring of air by high-volume or real-time methods until approved by the QA Representative.

3.7 FINAL REPORT

Contractor shall submit a final Air Monitoring Report at the conclusion of the project which shall include the results of all air sampling and analyses, meteorological measurements, real-time monitoring, equipment calibration and maintenance records and copies of the field logbook.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Air monitoring stations shall not be measured. This includes materials used in construction of the air monitoring stations and air sampling equipment.

Dust control will be considered incidental to the various work elements and will not be measured or paid separately.

Costs of testing samples shall be measured as number of tests run for each particular testing method. Air sampling media shall be considered incidental to testing.

Supplying power to the air monitoring station will not be measured and will be considered incidental to construction facilities and temporary control.

4.2 PAYMENT

Payment for construction of air monitoring stations, including fully installed air samplers, shall be in accordance with the approved Lump Sum bid. Aerosol monitors and meteorological measuring equipment shall not be paid for, but shall be considered incidental to the work.

Air sampling and laboratory analysis shall be paid for in accordance with the unit price schedule, based on the number of days indentified in the Contractor's schedule submitted with the bid. RMC will not pay for additional air monitoring or lead analysis required beyond the originally established completion date.

PAY ITEM	UNIT
Provide Air Monitoring Stations	Lump Sum
Lead Analysis	Each

END OF SECTION

ATTACHMENT C

Design Calculations

EXCAVATION VOLUME VS CELL CAPACITY

EXCAVATION VOLUME vs CELL CAPACITY

HWMU

ID	CF	CY
WP1A	20,083	744
WP1B	2,300	85
WP1C	1,805	67
WP1D	1,196	44
WP2A	29,446	1,091
WP2B	13,342	494
WP2C	2,773	103
WP3A	1,360	50
WP3B	3,317	123
WP6A	17,912	663
WP6B	456	17
MSB1A	13,933	516
MSB1B	1,778	66
MSB2A	12,125	449
MSB2B	9,968	369
	131,796	**4,881**

ON-SITE

ID	CF	CY
DW1	12,796	474
DW2	10,938	405
ND1	4,784	177
ND2	4,963	184
NW	10,562	391
FL1	4,407	163
FL2	18,444	683
FL3	31,799	1,178
FL4A	11,041	409
FL4B	4,552	169
FL5	35,408	1,311
	149,695	**5,544**

OFF-SITE

ID	CF	CY
AA1	7,957	295
AA2	3,826	142
AA3	4,515	167
AA4	4,820	179
AA5	2,267	84
AA6	14,932	553
CSX	5,489	203
CG1	936	35
CG2	2,704	100
AMT1	1,372	51
AMT2	5,874	218
AMT3	140	5
	54,831	**2,031**

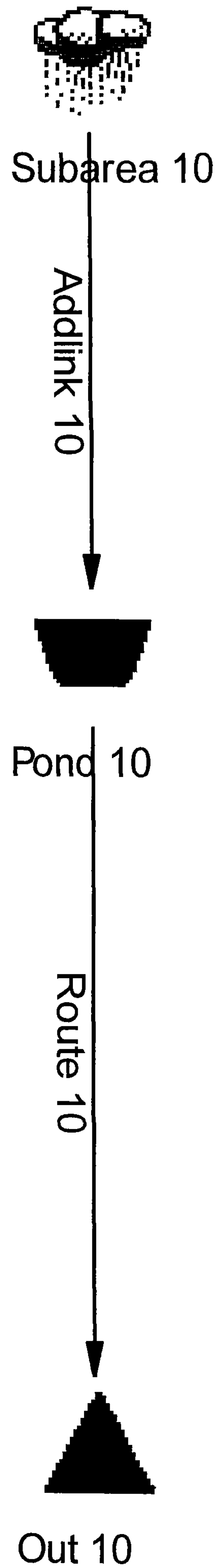
CONTAINMENT CELL WASTE CAPACITY

ELEVATION	AREA	DIFF DEPTH (FT)	VOL (CF)	CUM VOL (CF)	CUM VOL (CY)
838	52,808				
		2	111,641	111,641	4,135
840	58,833				
		2	111,641	223,281	8,270
842	52,808				
		2	99,879	323,160	11,969
844	47,071				
		2	88,693	411,853	15,254
846	41,622				
		2	78,084	489,937	18,146
848	36,461				
		2	68,050	557,987	20,666
850	31,589				
		2	58,593	616,580	22,836
852	27,004				
		2	49,711	666,291	24,677
854	22,707				
		2	41,406	707,697	**26,211**
856	18,699				

TOTAL EXCAVATION VOLUME **12,456 CY**

TOTAL CELL CAPACITY **26,211 CY**

STORM WATER MANAGEMENT CALCULATIONS


Subarea 10
Addlink 10
Pond 10
Route 10
Out 10

=========================
JOB TITLE
=========================

Project Date: 3/31/2010
Project Engineer: Paul Stratman
Project Title: RMC - Beech Grove
Project Comments:

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MASTER DESIGN STORM SUMMARY

Network Storm Collection: indianapolis

Return Event	Total Depth in	Rainfall Type	RNF ID
2	2.6400	Synthetic Curve	TypeII 24hr
5	3.6000	Synthetic Curve	TypeII 24hr
10	4.0800	Synthetic Curve	TypeII 24hr
25	4.8000	Synthetic Curve	TypeII 24hr
50	5.2800	Synthetic Curve	TypeII 24hr
100	6.0000	Synthetic Curve	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUT 10	JCT	2	1.374		12.5000	2.13		
*OUT 10	JCT	5	2.085		12.4000	3.71		
*OUT 10	JCT	10	2.447		12.4000	4.54		
*OUT 10	JCT	25	2.997		12.3500	5.75		
*OUT 10	JCT	50	3.366		12.3500	6.47		
*OUT 10	JCT	100	3.923		12.3500	7.37		
POND 10 IN	POND	2	1.376		11.9000	24.90		
POND 10 IN	POND	5	2.087		11.9000	37.31		
POND 10 IN	POND	10	2.450		11.9000	43.51		
POND 10 IN	POND	25	3.000		11.9000	52.78		
POND 10 IN	POND	50	3.369		11.9000	58.93		
POND 10 IN	POND	100	3.926		11.9000	68.12		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
POND 10 OUT	POND	2	1.374		12.5000	2.13	837.85	.743
POND 10 OUT	POND	5	2.085		12.4000	3.71	838.17	1.132
POND 10 OUT	POND	10	2.447		12.4000	4.54	838.33	1.326
POND 10 OUT	POND	25	2.997		12.3500	5.75	838.57	1.615
POND 10 OUT	POND	50	3.366		12.3500	6.47	838.73	1.810
POND 10 OUT	POND	100	3.923		12.3500	7.37	838.97	2.106
SUBAREA 10	AREA	2	1.376		11.9000	24.90		
SUBAREA 10	AREA	5	2.087		11.9000	37.31		
SUBAREA 10	AREA	10	2.450		11.9000	43.51		
SUBAREA 10	AREA	25	3.000		11.9000	52.78		
SUBAREA 10	AREA	50	3.369		11.9000	58.93		
SUBAREA 10	AREA	100	3.926		11.9000	68.12		

File.... F:\OFICEAGC\PROJECTS\Work\Beech Grove\pipe analysis.ppw

Title... Project Date: 3/31/2010
Project Engineer: Paul Stratman
Project Title: RMC - Beech Grove
Project Comments:

DESIGN STORMS SUMMARY

```
Design Storm File,ID =               indianapolis


Storm Tag Name       = 2
---------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 2 yr
Total Rainfall Depth= 2.6400 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       =      5
---------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 5 yr
Total Rainfall Depth= 3.6000 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       =     10
---------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 10 yr
Total Rainfall Depth= 4.0800 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       =     25
---------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 25 yr
Total Rainfall Depth= 4.8000 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs


Storm Tag Name       =     50
---------------------------------------------------------------------
Data Type, File, ID = Synthetic Storm    TypeII  24hr
Storm Frequency     = 50 yr
Total Rainfall Depth= 5.2800 in
Duration Multiplier =  1
Resulting Duration  = 24.0000 hrs
Resulting Start Time= .0000 hrs  Step= .1000 hrs  End= 24.0000 hrs
```

File.... F:\OFICEAGC\PROJECTS\Work\Beech Grove\pipe analysis.ppw

Title... Project Date: 3/31/2010
Project Engineer: Paul Stratman
Project Title: RMC - Beech Grove
Project Comments:

DESIGN STORMS SUMMARY

Design Storm File,ID = indianapolis

Storm Tag Name = 100

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 6.0000 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

TIME OF CONCENTRATION CALCULATOR

Segment #1: Tc: User Defined

Segment #1 Time: .0833 hrs

Total Tc: .0833 hrs

Tc Equations used...

==== User Defined ==

Tc = Value entered by user

Where: Tc = Time of concentration

File.... F:\OFICEAGC\PROJECTS\Work\Beech Grove\pipe analysis.ppw

RUNOFF CURVE NUMBER DATA

Soil/Surface Description	CN	Area acres	Impervious Adjustment %C	Impervious Adjustment %UC	Adjusted CN
Impervious	98	2.185			98.00
Gravel	91	4.464			91.00
Grass	84	2.854			84.00

COMPOSITE AREA & WEIGHTED CN ---> 9.503 90.51 (91)

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 5 year storm
Duration       = 24.0000 hrs     Rain Depth = 3.6000 in
Rain Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - SUBAREA 10 5
Tc             = .0833 hrs
Drainage Area = 9.503 acres  Runoff CN= 91

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    38.35 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    37.31 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

             DRAINAGE AREA
            -------------------
            ID:SUBAREA 10
            CN   =   91
            Area =       9.503 acres
            S    =    .9890 in
            0.2S =    .1978 in

             Cumulative Runoff
            -------------------
                    2.6359 in
                     2.087 ac-ft

HYG Volume...          2.087 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SUBAREA 10)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =   129.21 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.0800 in
Rain Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID  =  - TypeII  24hr
Unit Hyd Type  = Default Curvilinear
HYG Dir        = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID  =  - SUBAREA 10 10
Tc             = .0833 hrs
Drainage Area  = 9.503 acres   Runoff CN= 91

============================================
Computational Time Increment   =    .01111 hrs
Computed Peak Time             =   11.9222 hrs
Computed Peak Flow             =     44.64 cfs

Time Increment for HYG File    =     .0500 hrs
Peak Time, Interpolated Output =   11.9000 hrs
Peak Flow, Interpolated Output =     43.51 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
             -------------------
             ID:SUBAREA 10
             CN    =    91
             Area =        9.503 acres
             S     =    .9890 in
             0.2S =     .1978 in

             Cumulative Runoff
             -------------------
                     3.0940 in
                      2.450 ac-ft

HYG Volume...          2.450 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SUBAREA 10)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   129.21 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration       = 24.0000 hrs     Rain Depth = 4.8000 in
Rain Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - SUBAREA 10 25
Tc             = .0833 hrs
Drainage Area = 9.503 acres  Runoff CN= 91

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    54.03 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    52.78 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:SUBAREA 10
              CN   =   91
              Area =        9.503 acres
              S    =    .9890 in
              0.2S =    .1978 in

               Cumulative Runoff
              -------------------
                      3.7881 in
                       3.000 ac-ft

HYG Volume...          3.000 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SUBAREA 10)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,           qp =   129.21 cfs
Unit peak time       Tp =   .05556 hrs
Unit receding limb,  Tr =   .22222 hrs
Total unit time,     Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 50 year storm
Duration       = 24.0000 hrs     Rain Depth = 5.2800 in
Rain Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - SUBAREA 10 50
Tc             = .0833 hrs
Drainage Area = 9.503 acres  Runoff CN= 91

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    60.27 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    58.93 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
              -------------------
              ID:SUBAREA 10
              CN   =   91
              Area =        9.503 acres
              S    =     .9890 in
              0.2S =     .1978 in

              Cumulative Runoff
              -------------------
                      4.2543 in
                       3.369 ac-ft

HYG Volume...          3.369 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SUBAREA 10)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =    .7491)

Unit peak,          qp =   129.21 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
Duration       = 24.0000 hrs     Rain Depth = 6.0000 in
Rain Dir       = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir        = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
HYG File - ID =  - SUBAREA 10 100
Tc             = .0833 hrs
Drainage Area = 9.503 acres  Runoff CN= 91

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    69.59 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.9000 hrs
Peak Flow, Interpolated Output =    68.12 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

              DRAINAGE AREA
              -------------------
              ID:SUBAREA 10
              CN   =   91
              Area =        9.503 acres
              S    =    .9890 in
              0.2S =    .1978 in

              Cumulative Runoff
              -------------------
                      4.9572 in
                       3.926 ac-ft

HYG Volume...          3.926 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =    .08333 hrs (ID: SUBAREA 10)
Computational Incr, Tm =    .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =     .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   129.21 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 837.00 ft
Increment = .25 ft
Max. Elev.= 839.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Circular	C0	--->	TW	837.000	839.000
TW SETUP, DS Channel					

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = C0
Structure Type     = Culvert-Circular
------------------------------------
No. Barrels        =        1
Barrel Diameter    =   1.2500 ft
Upstream Invert    =   837.00 ft
Dnstream Invert    =   836.00 ft
Horiz. Length      =    45.67 ft
Barrel Length      =    45.68 ft
Barrel Slope       =   .02190 ft/ft

OUTLET CONTROL DATA...
Mannings n         =    .0130
Ke                 =    .2000  (forward entrance loss)
Kb                 =  .023225  (per ft of full flow)
Kr                 =    .2000  (reverse entrance loss)
HW Convergence     =     .001  +/- ft

INLET CONTROL DATA...
Equation form      =        1
Inlet Control K    =    .0018
Inlet Control M    =   2.0000
Inlet Control c    =   .02920
Inlet Control Y    =    .7400
T1 ratio (HW/D)    =    1.051
T2 ratio (HW/D)    =    1.196
Slope Factor       =    -.500
```

```
Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =     838.31 ft   --->  Flow =      4.80 cfs
At T2 Elev =     838.50 ft   --->  Flow =      5.49 cfs
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = TW
Structure Type     = TW SETUP, DS Channel
------------------------------------
FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations=    40
Min. TW tolerance =    .01 ft
Max. TW tolerance =    .01 ft
Min. HW tolerance =    .01 ft
Max. HW tolerance =    .01 ft
Min.  Q tolerance =    .00 cfs
Max.  Q tolerance =    .00 cfs
```

```
                    LEVEL POOL ROUTING SUMMARY

 HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
 Inflow  HYG file = NONE STORED - POND 10      IN  2
 Outflow HYG file = NONE STORED - POND 10      OUT 2

 Pond Node    Data = POND 10
 Pond Volume Data = POND 10
 Pond Outlet Data = pipe

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =   837.00 ft
 Starting Volume     =     .000 ac-ft
 Starting Outflow    =      .00 cfs
 Starting Infiltr.   =      .00 cfs
 Starting Total Qout=       .00 cfs
 Time Increment      =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =     24.90 cfs    at   11.9000 hrs
 Peak Outflow      =      2.13 cfs    at   12.5000 hrs
 -----------------------------------------------------
 Peak Elevation    =    837.85 ft
 Peak Storage =            .743 ac-ft
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       1.376
- Infiltration  =        .000
- HYG Vol OUT   =       1.374
- Retained Vol  =        .002
                   ----------
  Unrouted Vol =       -.000 ac-ft  (.016% of Inflow Volume)
```

```
                    LEVEL POOL ROUTING SUMMARY

 HYG Dir          = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
 Inflow  HYG file = NONE STORED - POND 10      IN  5
 Outflow HYG file = NONE STORED - POND 10      OUT 5

 Pond Node   Data = POND 10
 Pond Volume Data = POND 10
 Pond Outlet Data = pipe

 No Infiltration

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev    =   837.00 ft
 Starting Volume     =     .000 ac-ft
 Starting Outflow    =      .00 cfs
 Starting Infiltr.   =      .00 cfs
 Starting Total Qout=       .00 cfs
 Time Increment      =    .0500 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 =====================================================
 Peak Inflow       =     37.31 cfs    at   11.9000 hrs
 Peak Outflow      =      3.71 cfs    at   12.4000 hrs
 -----------------------------------------------------
 Peak Elevation    =    838.17 ft
 Peak Storage =          1.132 ac-ft
 =====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       2.087
- Infiltration =         .000
- HYG Vol OUT   =       2.085
- Retained Vol =         .002
                  ----------
 Unrouted Vol =        -.000 ac-ft  (.010% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file = NONE STORED - POND 10      IN  10
Outflow HYG file = NONE STORED - POND 10      OUT 10

Pond Node    Data = POND 10
Pond Volume Data = POND 10
Pond Outlet Data = pipe

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   837.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =     43.51 cfs    at   11.9000 hrs
Peak Outflow      =      4.54 cfs    at   12.4000 hrs
-----------------------------------------------------
Peak Elevation    =    838.33 ft
Peak Storage =          1.326 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =       2.450
- Infiltration =        .000
- HYG Vol OUT  =       2.447
- Retained Vol =        .002
                  ----------
  Unrouted Vol =       -.000 ac-ft  (.009% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file = NONE STORED - POND 10       IN  25
Outflow HYG file = NONE STORED - POND 10       OUT 25

Pond Node   Data = POND 10
Pond Volume Data = POND 10
Pond Outlet Data = pipe

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   837.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs

INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =     52.78 cfs    at   11.9000 hrs
Peak Outflow      =      5.75 cfs    at   12.3500 hrs
-----------------------------------------------------
Peak Elevation    =   838.57 ft
Peak Storage =          1.615 ac-ft
=====================================================

MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       3.000
- Infiltration =        .000
- HYG Vol OUT   =       2.997
- Retained Vol =        .002
                  ----------
  Unrouted Vol =       -.000 ac-ft   (.007% of Inflow Volume)
```

```
                    LEVEL POOL ROUTING SUMMARY

  HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
  Inflow  HYG file = NONE STORED - POND 10      IN  50
  Outflow HYG file = NONE STORED - POND 10      OUT 50

  Pond Node   Data = POND 10
  Pond Volume Data = POND 10
  Pond Outlet Data = pipe

  No Infiltration

  INITIAL CONDITIONS
  ----------------------------------
  Starting WS Elev    =   837.00 ft
  Starting Volume     =     .000 ac-ft
  Starting Outflow    =      .00 cfs
  Starting Infiltr.   =      .00 cfs
  Starting Total Qout=       .00 cfs
  Time Increment      =    .0500 hrs


  INFLOW/OUTFLOW HYDROGRAPH SUMMARY
  ====================================================
  Peak Inflow       =     58.93 cfs    at   11.9000 hrs
  Peak Outflow      =      6.47 cfs    at   12.3500 hrs
  ----------------------------------------------------
  Peak Elevation    =    838.73 ft
  Peak Storage =          1.810 ac-ft
  ====================================================


  MASS BALANCE (ac-ft)
  --------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       3.369
- Infiltration =         .000
- HYG Vol OUT   =       3.366
- Retained Vol =         .002
                    ----------
  Unrouted Vol =       -.000 ac-ft  (.006% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir           = F:\OFICEAGC\PROJECTS\Work\Beech Grove\
Inflow  HYG file = NONE STORED - POND 10      IN  100
Outflow HYG file = NONE STORED - POND 10      OUT 100

Pond Node   Data = POND 10
Pond Volume Data = POND 10
Pond Outlet Data = pipe

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev    =   837.00 ft
Starting Volume     =     .000 ac-ft
Starting Outflow    =      .00 cfs
Starting Infiltr.   =      .00 cfs
Starting Total Qout=       .00 cfs
Time Increment      =    .0500 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =      68.12 cfs    at    11.9000 hrs
Peak Outflow      =       7.37 cfs    at    12.3500 hrs
-----------------------------------------------------
Peak Elevation    =    838.97 ft
Peak Storage =         2.106 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol   =        .000
+ HYG Vol IN    =       3.926
- Infiltration =         .000
- HYG Vol OUT   =       3.923
- Retained Vol =         .002
                    ----------
  Unrouted Vol =       -.000 ac-ft   (.005% of Inflow Volume)
```

Index of Starting Page Numbers for ID Names

ATTACHMENT D

Construction Quality Assurance Plan

CONSTRUCTION QUALITY ASSURANCE PLAN
CORRECTIVE MEASURES IMPLEMENTATION
REFINED METALS CORPORATION
BEECH GROVE, INDIANA

Prepared For:

Refined Metals Corporation
Beech Grove, Indiana

Prepared By:

ADVANCED GEOSERVICES CORP.
West Chester, Pennsylvania

Project No. 2003-1046-18
April 12, 2010

TABLE OF CONTENTS

LIST OF APPENDICES

1.0 OBJECTIVE

Quality Assurance is defined as a planned and systematic pattern of means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service. Quality Control is defined as those actions which provide a means to measure and regulate the characteristics of an item or service in accordance with contractual and regulatory requirements.

This Construction Quality Assurance Plan (CQAP) establishes the quality assurances procedures for implementation of the Corrective Measures (CM) Design at the former Refined Metals Corporation (RMC) facility in Beech Grove Indiana. The purpose of the CQAP is to ensure that the quality control objectives spelled out in the specifications are being met and that RMC receives a quality project that will serve its intended purpose with minimal maintenance. The activities involving quality assurance activities identified in this CQAP include the following:

- Erosion and sediment control
- Transportation of waste materials
- Dust control
- Demolition of remnant structures
- Surveying
- Soil and sediment remediation
- Earthwork
- Containment cell capping
- Restoration

2.0 RESPONSIBILITIES

Owner: Refined Metals Corporation Beech Grove (RMC).

Engineer: Advanced GeoServices Corp

Contractor: The party responsible for overall implementation of the CM Design including, but not limited to, site preparation, remediation, demolition, material handling and management, earthwork, earthwork, dust control and air sampling, water management, containment cell construction and capping, and site restoration. While portions of the work associated with implementation of the CM Design may be subcontracted by the Contractor, the Contractor is ultimately responsible for overall quality of the completed project and completion within the agreed upon schedule and budgetary amounts.

Manufacturer: The party responsible for the production and/or supplying of products and materials purchased from off-site vendors. This shall include, but not be limited to, everything from temporary controls, such as silt fence, to imported soil, aggregate and topsoil, to geosynthetic components within the containment cell cap. The Contractor is ultimately responsible for ensuring that the materials and products utilized for the project meet the requirements of the specifications and are installed in accordance with the requirements and intent of the CM Design, including this CQAP. If the Contractor wishes to propose an alternate product or material in lieu of a specified material or because the material is no longer available or inappropriate for actual field conditions, the Contractor shall notify the QA Representative and seek approval prior to delivery of such materials or products to the site.

Installer: The party responsible for field handling, transportation, storing, deploying, seaming, temporary restraining (against wind), and installation of the geosynthetic components of the containment cell cap. (In some cases, the Manufacturer and Installer or Contractor and Installer could be the same party). The Installer shall be retained by the Contractor as a subcontractor.

Quality Assurance (QA) Representative: The party retained by RMC and independent from the Contractor or any of the Contractor's subcontractors that is responsible for observing and documenting activities related to the quality assurance of the work and compliance with the requirements of the CM Design. The QA Representative will be on-site on a full-time basis and will maintain open lines of communication between the Contractor, RMC, the CM Design Engineer, regulatory representatives.

Quality Assurance Analytical Testing Laboratory: The party retained by QA Representative for the purpose of analyzing confirmatory samples and supplemental sampling of borrow source materials, crushed concrete or other analysis as deemed appropriate during the work.

Contractor's Analytical Testing Laboratory: The party retained by Contractor for the purpose of analyzing borrows source materials, air samples, crushed concrete or other analysis as deemed appropriate during the work. The QA Analytical Testing Laboratory and the Contractor's Analytical Testing Laboratory shall not be the same lab.

Geosynthetic Testing Laboratory: The party, independent from the Contractor, Manufacturer, and Installer, responsible for conducting tests on samples of the geomembrane field seams obtained at the site. Laboratory to be retained by Contractor or Installer and approved by RMC.

3.0 QUALIFICATIONS

General

Presented in this section are the minimum qualification requirements for the key organizations involved with the implementation of the CM Design. The minimum standards must be demonstrated for each of the major categories listed. Where the specific services will be performed by a subcontractor, the primary contractor must provide documentation of appropriate experience for all subcontractors proposed for the project. All personnel performing intrusive activities or working in areas of exposed contaminants shall have a minimum of 40-hours of safety training with a current 8-hour annual refresher in accordance with 29 CFR 1910.120.

QA Representative

The QA Representative shall be experienced in construction and remediation projects, shall possess strong written and verbal skills and have experience in material placement and compaction, earthwork activities, geosynthetic installation, environmental sampling and understand basic surveying techniques.

Contractor

The Contractor shall have experience in constructing projects of similar size and scope and shall have completed at least six projects involving the remediation of soil and sediment impacted by inorganic contaminants. All employees of the Contractor shall have a minimum of 40- hours of safety training with current 8-hour annual refresher in accordance with 29 CFR 1910.120, and required site training.

Installer

The Installer shall be licensed or approved to install the Manufacturer's geomembrane. The Installation Supervisor shall have installed or supervised the installation of a minimum of 5,000,000 square feet of High Density Polyethylene (HDPE) liner. The Master Seamer shall have installed a minimum of 5,000,000 square feet of HDPE experience. All other seamers shall have installed a minimum of 500,000 square feet of geomembrane. All employees of the Installer shall have a minimum of 40-hours of safety training with current 8-hour annual refresher in accordance with 29 CFR 1910.120.

4.0 INSPECTION ACTIVITIES

Erosion and Sediment Control

Prior to construction, the Contractor is required to submit manufacturer's information for silt fence, construction entrances, contaminant reduction zones and related erosion and sediment control materials as described in Specification Section 02115. The QA representative shall review the Contractor's submittals for compliance with the requirements of the Specifications and CM design.

The erosion and sediment controls provide protection against the transport of potentially contaminated sediment from the active remediation area and protection against the any sediment from those areas not designated for remediation and those areas where remediation has been completed. During execution, the QA Representative shall ensure that erosion and sediment controls are installed as required to prevent the migration of sediment laden water (contaminated or uncontaminated) and that water from areas designated for remediation do not cross-contaminate clean areas. The review will evaluate actual site conditions against the requirements for erosion and sediment control measure as depicted on Sheet 4 of the design drawings and may adjust the proposed location, amount and type of control to fit actual conditions. The review will be conducted in cooperation with the Contractor and with input from the CM Engineer as appropriate.

As work progresses site conditions will likely change and the integrity of the silt fence may degrade because of siltation, damage or general disturbance. The QA Representative will evaluate the adequacy of installed erosion and sediment measures at a minimum on a weekly basis, after each runoff producing precipitation event and when the active work zone progresses. The QA representative shall ensure that the Contractor removes accumulated sediment from erosion and sediment control measures protecting active remediation areas prior to approving restoration of the remediation areas.

<u>Transportation of Waste Materials</u>

Each load of waste material destined for off-site disposal (demolition debris not approved for placement in the Containment Cell) will be transported under a properly executed Bill of Lading or Hazardous Waste Manifest, as appropriate and as required by Specification Section 01355. Each bill of lading or manifest will be numbered sequentially to allow the number of loads hauled from the site to be tracked. Truck loading will be monitored to help prevent trucks from being overloaded, although ultimately it will be the drivers and Contractor's responsibility to be certain trucks are not overloaded. Prior to leaving the loading area the bed of each hauling unit will be covered with a closely woven net tarp or canvass tarp to prevent the escape of windblown soil during transportation to the disposal facility. Each truck will be decontaminated in the Contamination Reduction Zone (CRZ) as required to prevent the off-site migration of contaminated materials. The loading area will be maintained in a clean manner, spilled material will be cleaned up as necessary. The designated truck route to the selected disposal facility will be presented to each truck driver prior to leaving the site.

The QA Representative will be responsible ensuring that RMC has approved the proposed disposal or recycling destination and waste profiles have been signed by RMC and approved by the destination facility. The QA representative shall record in his fieldbook when shipments are sent off-site, the classification of the waste (hazardous versus non-hazardous), and the destination facility. The QA representative shall track that proof of disposal and disposal weight for each shipment has been received from the Contractor.

Dust Control and Air Monitoring

It is the intent of RMC to have the Contractor perform proposed CM construction activities in a manner capable of achieving the National Ambient Air Quality Standards (NAAQS) for lead. Specification Section 02999 provides the dust control and air monitoring requirement. As shown, the Contractor is responsible for providing real-time and time-integrated air sampling. The QA Representative shall review Contractor submittals for proposed sampling equipment, analytical laboratory, sampling station/platform configuration, and qualification of Contractor personnel. The locations for the proposed time-integrated samplers (TSP and total lead samplers) shall be situated as shown on Sheet 4 of the design drawings and may only be changed with consensus approval of RMC, USEPA, IDEM and CM Engineer.

The Contractor will be required to provide real-time monitoring around the perimeter of the active remediation zone. The QA representative will calculate an allowable Trigger Level for the real-time active work zones utilizing the average lead concentration for the area being remediated and a target maximum lead in air concentration of 0.15 mg/m3.

An example calculation would be as follows:

Average lead concentration of soil being remediated = 2,000 mg/kg = 0.002 mg/mg
Target Maximum lead in air concentration = 0.15 mg/m3

Trigger Level = (0.15 mg/m3)/0.002 mg/mg = 75 mg/m3

The Trigger Level represents a conservative value to utilize as a real-time measure for dust control. During execution it is possible that the Contractor may not be able to meet the calculated value when working in a very high concentration area. When an exceedance occurs; the Contractor shall temporarily stop work, review site conditions with the QA Representative, identify alternate/additional measures and implement the agreed upon measures before continuing work. If the area continues to exceed the Trigger Level the determination to allow continued work will be made based by the QA Representative in consultation with RMC. Short-term periods when a Trigger Level is exceeded will not be considered a failure of the dust control standards, but regular or protracted exceedances will not be permitted.

During execution of the work, the QA representative will review periodically throughout each work day the location and level of protection being provided by the Contractor. The QA Representative will obtain information regarding the wind direction and wind speed periodically during the day and record the information in the fieldbook. In addition, the Contractor is required to submit daily records with the Daily Report. The QA representative will consider wind speed and direction when evaluating the adequacy of dust control measures. Under high wind or extreme dry conditions it may be necessary for the Contractor to suspend work.

The QA Representative shall ensure that the methods and means being utilized for dust control are adequate for the site conditions and activities. The QA Representative shall have the authority to stop the work if he/she believes that the dust control procedures being utilized are inadequate. Adequacy of dust controls will be determind based on visual observations, real-time air monitoring, and laboratory TSP and lead results for the high volume air monitors.

<u>Demolition of Remnant Structures</u>

The QA representative shall review the Contractor's schedule, techniques and proposed limits for the required demolition and confirm that the work is coordinated with other work activities, that the techniques are appropriate for the nature of the demolition and the limits are consistent with the CM Design.

Surveying

The QA Representative shall review the approach to surveying proposed by the Contractor's Surveyor for technical approach and consistency with the CM Design. Specific attention will be given to the proposed grid system and cross-sections and establishment of bench marks. The elevation of each grid shall be surveyed prior to excavation or demolition and the system utilized must be reproducible to allow the documentation of removal depths relative to starting elevations and the adequacy of restoration. This data will be compared with the site characterization previously performed to insure that the depth of excavation is adequate. The Contractor is permitted to monitor removal depths using his own equipment provided that the monitoring is tied to within 1.0 feet of the originally established grid and cross-sections and accurate to within 0.1 feet vertically.

Soil and Sediment Remediation

The Surveyor will stakeout the horizontal limits of the removal areas, and the QA Representative and Contractor shall review the staked limits for consistency with the design and actual field conditions. Discrepancies or concerns should be raised with the CM Engineer prior to the start of excavation in the subject area. The QA Representative shall review the Contractor's protocol and controls for establishing removal limits.

The QA Representative shall confirm that affected soil and sediments are placed in the Containment Cell in accordance with following performance criteria indentified in the CM Design.

The QA Representative shall confirm that:

- Property Owner approvals have been received.
- Water management features have been established prior to the start of removal.

- The limits of initial excavation have been clearly marked and the existing elevations have been documented prior to the start of work.
- Excavations are conducted using methods approved by the QA Representative which prevent transport of sediments and minimize generation of water.
- Excavation sequencing is conducted as proposed by the Contractor and approved by QA Representative and RMC.
- Excavations have extended only to the limits marked, unless analytical data collected by the QA Representative confirms that additional excavation is necessary.
- The Contractor is employing measures to prevent contamination of soils not indicated for excavation.
- The excavation depth has extended to the depths identified in the CM Design (+/- 3-inches) or as directed by the QA Representative based on the previous sampling results.
- Confirmatory sampling has been conducted by the QA Representative.
- All visible waste materials (slag and battery casings) have been removed to the satisfaction of the QA Representative.
- Measures are employed to minimize the amount of water generated during construction. Water removed from within the excavation is contained and treated.
- Excavations are conducted to obtain the performance standards identified in the CM Design.
- Excavated materials are transported directly to the containment cell for placement.
- Materials being placed in the containment cell are placed in 12 inch loose lifts and are being compacted in a manner to create a stable surface capable of supporting the final cap.
- Material is placed in the containment cell using the sequencing proposed by the Contractor and approved by the QA Representative.
- The maximum material size is 12 inches in the longest direction.

- The top 6 inches of material are remediated soils with a maximum particle size of 2-inches.
- Cleared and grubbed materials not shipped off-site or approved for use elsewhere on-site is ground (<3 inches in longest dimension) and placed in a single 4 inch thick maximum lift.

Sampling and Analysis

The QA Representative will ensure that the confirmatory sampling discussed in the CM Design and the SAP included as part of this CQAP are followed.

Earthwork

Imported topsoil and/or fill shall be tested for compliance with the specifications prior to delivery to the site. Topsoil placement shall be monitored to ensure that it has graded to promote drainage and prevent ponding and that it has been placed to the depth specified. Topsoil materials whether placed for turf establishment or placed to sustain sod shall be fertilized and amended as recommended based on the agronomy testing required by the Specifications.

The QA Representative shall monitor the placement and compaction of on-site fill materials to insure that it is being placed and adequately compacted to prevent future settlement and promote positive drainage. The QA representative shall receive and review copies of the geotechnical laboratory and field density testing performed by the Contractor's geotechnical engineer.

Containment Cell Capping

The QA Representative shall review and discuss the Contractors proposed approach (construction sequence and construction techniques) for capping the containment cell. To the extent possible, installation of the geomembrane shall be completed as soon as possible after the final tops of waste elevations are achieved. If the time between achieving final grades and geomembrane installation will be greater than one week, the Contractor shall be required to protect the completed surface using temporary plastic sheeting placed in such a manner to shed precipitation and prevent direct contact of precipitation with the contaminated soils.

The 18-inch thick cover soil layer shall be placed as a single lift and construction equipment (except small rubber tired ATVs utilized by the Installer during geosynthetic deployment) will not be permitted on to the areas of the completed geomembrane installation until the cover soil layer is in-place. QA Representative shall ensure that all required inspections and documentation of the liner installation activities is completed prior to soil placement.

Topsoil will be submitted to a soils laboratory for analysis to insure that the topsoil is amended with the proper amount of fertilizer and agricultural lime. Seed and fertilizer shall be selected and applied as recommended by the local USDA Soil Conservation Office. Seed variety will be selected based upon the time of year the planting is to be completed and to insure a viable stand of grass is established that will require a minimum amount of maintenance. Seed shall be state-certified seed of the latest season's crop.

5.0 SAMPLING REQUIREMENTS

The QA Representative shall report the analytical results for post-excavation sampling, with appropriate sample identification and location, to RMC and Contractor within 24 hours of receiving the results from the laboratory.

The QA Representative in consultation with RMC and the Contractor, will determine the limits and extent of further excavation based upon the results of the sample analysis. RMC and its representatives may request additional samples for analysis to assist in the determination. Excavation and confirmatory sampling will continue until the performance criteria have been met.

The QA Representative shall ensure that:

- Sampling is conducted at the frequency indicated in the Specifications.
- Post-excavation samples within HWMUs are analyzed for total lead, arsenic, antimony, cadmium and selenium. Post-excavation samples outside of HWMUs are analyzed for total lead.
- Performance standards are as indicated in the Specifications.

6.0 DOCUMENTATION

An effective CQAP depends largely on recognition of all construction activities that should be monitored, and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of Quality Assurance activities. The QA Representative will document that the Quality Assurance requirements have been addressed and satisfied.

Following review, the QA Representative will provide the RMC with signed descriptive remarks, data sheets, and logs to verify that the monitoring activities have been carried out in accordance with the CQAP and that performance standards established in the CM Design Report have been achieved. The Contractor will maintain at the Site a complete file of the CM Design Report, Drawings and Specifications, CQAP, checklists, test procedures, daily logs, and other pertinent documents.

Daily Recordkeeping

The QA Representative's standard reporting procedures will include preparation of a daily CQA report which, at a minimum, will consist of:

- a discussion of Site activities, including CQC testing, performed during the day;
- CQA and regulatory personnel and visitors present at the Site;
- field notes, including memoranda of meetings and/or discussions with participating parties or regulatory authorities;
- CQA monitoring logs and testing data sheets;
- construction problem and solution summary sheets;
- submittal status;
- date and weather conditions; and,

- signature of the QA Representative.

This information will be regularly submitted to and reviewed by RMC.

Monitoring Logs and Test Data Sheets

CQC monitoring logs and test data sheets will be prepared daily by the Contractor. When QA testing is performed, related monitoring logs and test data sheets shall be completed by the QA Representative for that work. At a minimum, these logs and data sheets will include the following information:

- an identifying sheet number for cross referencing and document control;
- date, project name, location, and other identification;
- data on weather conditions;
- descriptions and locations of ongoing construction;
- equipment and personnel in each work area, including subcontractors;
- descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- locations where tests and samples were taken;
- a summary of test results;
- calibrations or recalibrations of test equipment, and actions taken as a result of recalibration;
- delivery schedule of off-site materials received, including Quality Control documentation;
- decisions made regarding acceptance of units of work, and/or removal activities to be taken in instances of substandard quality; and,
- signature.

RMC will be made aware of any significant recurring non-conformance with the Specifications. The CM Engineer will review the issues with the QA Representative to determine the cause of the non-conformance and recommend appropriate changes in procedures or Specifications. These changes will be submitted to the IDEM and the USEPA, as appropriate.

A summary of the supporting data sheets, along with final testing results and the QA Representative's and Resident Engineer's approval of the work, will be required upon completion of construction.

Photographic Documentation

Photographs will be taken by the Contractor in order to serve as a pictorial record of work progress, problems, and removal activities. The basic file will contain color prints, labeled with the date, and subject of the photograph. Negatives will also be stored in a separate file in chronological order. These records will be presented to the Project Coordinator upon completion of the project. Photographic reporting data sheets, where used, will be cross-referenced with observation and testing data sheet(s), and/or construction problem and solution data sheet(s). The Contractor will allow the RMC representatives to examine photographs at the Site, upon request.

Corrective Measures Design Plan and/or Specification Changes

The CM Design and/or Specifications changes may be required during construction. In such cases, the Contractor will notify RMC and QA Representative when a change is believed to be warranted. Changes will be made only with the written agreement of the CM Engineer (following review and consultation with QA Representative, IDEM and USEPA, if necessary), and will take the form of an addendum to the Specifications.

Signatures and Final Report

At the completion of the work, the QA Representative will submit to RMC signed and sealed Final Reports. These reports will include an appropriate certification statement and will certify: (i) that the work has been performed in compliance with the CM Design; (ii) physical sampling and testing, except as properly authorized, have been conducted at the appropriate frequencies; and (iii) that the summary document provides the necessary supporting information.

At a minimum, this report will include: (i) summaries of all construction activities; (ii) testing data sheets including sample location plans; (iii) construction problems and solutions data sheets; (iv) changes from design and Specifications; (v) record (as-built) drawings (to be provided by the Cotnractor); and (vi) a summary statement sealed and signed by a Professional Engineer registered in the State of Indiana.

The as-built drawings provided by the Contractor will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g. depths, plan dimensions, elevations, etc.). All surveying and base maps required for development of the record drawings will be prepared by the Contractor's qualified licensed land surveyor.

The documentation and information to be collected by the QA Representative from the Contractor for use in development of the Final Report shall include the following:

- Surveyor qualifications, including proof of Health and Safety training;
- Geomembrane Manufacturer qualifications;
- Geomembrane Installer qualifications;
- Other subcontractor qualifications;
- Contractor's Health and Safety Plan;

- Project record (as-built) drawings as required by Specification Section 01050;
- Restoration summary;
- Permits obtained by Contractor or Owner;
- Representative photographs;
- Validated soil sampling results including laboratory reports;
- If used, off-site disposal completed manifests, weight tickets, and certificates of disposal;
- Compaction test results;
- QC certificates for each roll of geosynthetic;
- Geomembrane panel layout plans;
- Installer's geomembrane certification;
- Destructive seam sample test results;
- Shear box test results;
- Quality Assurance monitoring logs and test data sheets;
- Material properties for:

    - Silt fence, and other erosion and sediment control devices;
    - CRZ and construction entrance aggregate and geotextile;
    - Water treatment system and procedures;
    - Cap geomembrane;
    - Geocomposite;
    - Aggregate and piping for cap anchor trench and outfalls;
    - Cover soil;
    - Topsoil and erosion control mat;
    - Seed, mulch and fertilizer;
    - Stormwater system piping, outlet structures and other features;
    - Fencing;

- Asphaltic Concrete Paving;
- Other site materials.

- Delivery tickets and/or certificates of compliance for all materials;
- Completed submittal register and approved submittals; and,
- Any other information needed for documentation of work in accordance with the Contract Documents.

Storage of Records

During performance of remediation activities, all records, including handwritten data sheet originals (especially those containing signatures), should be stored by the Contractor or his designee in a safe on-site repository. Other reports may be stored by a standard method which will allow for easy access.

APPENDIX A
CONFIRMATORY SAMPLING

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1.0 INTRODUCTION

1.1 GENERAL

As presented in Section 5.0 "Statement of Basis" of the Corrective Measures Design Report (Design Report), the proposed remedial activities within the horizontal limits of the former Hazardous Waste Management Units (HWMUs) shall be performed as Closure under the purview of the Indiana Department of Environmental Management (IDEM), while remediation on the remainder of the site and off-site are being performed as part of Corrective Measures under the purview of the United States Environmental Protection Agency (USEPA). Therefore, multiple remediation standards are being applied to the site. The soil standards, as discussed to greater detail in Section 5.0 of the Design Report are as follows:

1.2 CORRECTIVE MEASURES (ON-SITE AND OFF-SITE)

1.2.1 On-Site

Soil and sediment remediation on the former RMC property (outside the footprint of the HWMUs) and off-site are dictated specifically by lead. The standard for on-site for soil and sediment (outside the limits of the HWMUs) is 920 mg/kg, which corresponds to the Preliminary Remediation Goal (PRG) calculated through a site specific Baseline Human Health Risk Assessment (BHHRA) presented in and approved as part of the Corrective Measures Study (Advanced GeoServices August 6, 2007). The PRG represents the maximum allowable average concentration within a defined exposure area for the depth intervals considered in the BHHRA. For this project there are two exposure areas referred to as the "on-site exposure area" and the "grassy exposure area" (See Design Report, Figure 2) and the depth increments ("exposure depth") are 0-5 feet and 0-2.5 feet respectively.

1.2.2 Off-Site

As shown on Sheets 7 and 8, the proposed off-site excavation areas coincide with drainage ditches and swales that received surface water runoff from the facility. Sampling conducted as part of the RFI identified elevated concentrations of lead in the sediment and soil within these features. The lead remediation value for sediment and soil within these generally accessible Off-Site Areas is 400 mg/kg. The proposed soil and sediment removal is limited to the bottoms of the drainage features where concentrated surface water runoff has resulted in a lead concentrations >400 mg/kg. Within the less clearly defined drainage swale along South Arlington Avenue, the proposed excavation activities will extend from the site security fence to the edge of pavement for the road.

1.3 HAZARDOUS WASTE MANAGEMENT UNIT CLOSURE

Soil remediation within the limits of the former HWMUs is dictated by lead, as well as antimony, arsenic, cadmium and selenium. The soil remediation standards are shown below. The standards come from the IDEM RISC Industrial Closure Levels, Table A (antimony, arsenic, cadmium and selenium), while the value for lead represents the IDEM RISC Industrial Closure Levels for Construction.

Hazardous Waste Management Units (HWMUs)

Parameter	Soil Standard
Antimony	37 mg/kg
Arsenic	20 mg/kg
Cadmium	77 mg/kg
Lead	970 mg/kg
Selenium	53 mg/kg

As discussed in Section 5.0 of the Design Report, the values for lead and arsenic were justified based on site specific SPLP testing which demonstrated average partitioning coefficients more than an order of magnitude greater than the values utilized to calculate the IDEM RISC default Migration to Groundwater values.

2.0 CONFIRMATORY SAMPLING REQUIREMENTS

2.1 RMC PROPERTY (EXCLUDING HWMUs)

The removal limits shown on Sheet 7 of the design drawings have been selected to remove the highest concentration soils within each exposure area as necessary to achieve an average soil lead concentration (PRG) within the BHHRA exposure depth (0 to 5 feet within the On-Site Exposure Area and 0 to 2.5 feet within the Grassy Exposure Area) equal to or less than 920 mg/kg. It is also the intention of RMC that the remaining soil lead concentration at the bottom of each removal area on the RMC property be less than 920 mg/kg as determined through post excavation sampling at the bottom of the excavation area.

No excavation sidewall sampling or sampling beyond the horizontal limits of the excavation is required. Bottom confirmatory samples will be performed by the QA Representative utilizing an XRF with a minimum 20 percent of the samples sent off-site for laboratory analysis. The number of bottom samples required within each excavation area is listed on table presented on Sheet 7 of the design drawings and the actual locations will be determined randomly utilizing a 10 foot by 10 foot grid superimposed over the excavation area.

Samples for XRF analysis will be collected utilizing decontaminated or disposable sampling equipment from a depth interval of 0-6 inches. The samples will be placed into separate clean plastic baggies and homogenized by hand (protected by a clean glove) for approximately 1 minute. After homogenization the XRF will be utilized to analyze the sample for lead in accordance with the USEPA's SW-846, Method 6200. Five readings will be taken from each sample and recorded in the fieldbook and the results averaged to provide the uncorrected representative concentration. A minimum of 20 percent of the soil samples will be submitted to the Quality Assurance Analytical Laboratory for total lead analysis. The laboratory results will be evaluated against the corresponding average XRF concentration and a correction factor (regression equation) will be developed. The correction factor will be applied to those XRF sample results without a corresponding laboratory result. Utilizing the available laboratory results and the corrected average results for each sample, the 95% UCL for each remediation area will be calculated and compared against the 920 mg/kg PRG. If the 95% UCL is less than 920 mg/kg then the excavation area will be deemed complete. If the 95% UCL is greater than 920 mg/kg then additional excavation will be performed within portions of the excavation area as designated by the QA Representative. The amount of additional removal will be determined by the QA Representative based on the observed sampling results and visual conditions within the excavation. After re-excavation the remediated portions will be resampled at locations approximating the locations of the previous samples and analyzed with the XRF following the same protocol described above. The average XRF result will be corrected using the correction factor and the 95% UCL recalculated. This process shall be repeated until acceptable results are achieved.

If distinct layers or pockets of slag or battery casing materials are observed in the bottom or sidewalls of the excavation area, the QA Representative will require selective removal of the identified material.

2.2 OFF-SITE

The removal depths shown on Sheet 8 of the design drawings have been selected to remove the soil and sediment materials which exceed 400 mg/kg. No sidewall sampling or sampling beyond the horizontal limits of the proposed excavation is required, except along the southern limit of excavations areas AMT-1, 2 and 3. Completeness of the vertical removal, and southern limit of excavation areas AMT-1, 2 and 3, will be determined using the XRF with 20% laboratory confirmation as described above. The number of bottom samples required within each excavation area is listed on table presented on Sheet 8 of the design drawings. Sidewall samples shall be collected at a minimum frequency of once every 20 feet of side wall, but no less than 3 measurements will be taken in any excavation. Where sidewalls exhibit distinct horizons as determined by the QA Representative based on soil texture, color and structure, sidewall sampling shall be performed separately for each horizon. Side wall samples shall be collected across a 6-inch increment for the horizon represented by the sample.

Results of the XRF analysis within each excavation area will be averaged, adjusted utilizing the correction factor and the 95% UCL calculated. The calculated 95% UCL will be compared against 400 mg/kg. If the average exceeds 400 mg/kg, then additional removal will be required. The amount of additional removal will be determined by the QA Representative based on the observed sampling results. Following additional removal, the confirmatory sampling process will be repeated for those areas subject to additional removal at locations approximating the previous confirmatory sample location. In addition, if distinct layers or pockets of slag or battery casing materials are observed in the bottom or sidewalls of the excavation area, the QA Representative will require selective removal of the identified material.

2.3 HAZARDOUS WASTE MANAGEMENT UNITS

The proposed removal depths shown within the former HWMUs have been established based on the results of the soil sampling. Horizontal limits have been defined based on the regulatory limits (e.g. edge of the HWMU) and physical limits (such as building walls) of the units. Where the boundary of a proposed excavation area is not defined by a regulatory or physical limit, the area has been delineated based on professional judgment and interpretation relative to surrounding results.

The HWMUs are being clean-closed to the soil contaminant levels listed above, following the general procedures established in the IDEM RISC Program. In accordance with those requirements, confirmatory samples must be collected from the bottoms and sidewalls of the excavations.

The number of locations screened on the bottom of the excavations will be determined by the area of each excavation and will follow IDEM standard guidance for post-excavation sampling set forth in the IDEM RISC Technical Guide. The area of each excavation and number of screening locations is provided on Sheet 6 of the design drawings.

Sidewall screening will also be performed in all HWMU excavations according to IDEM guidance documents, by performing screening every 20 feet. However, no screening will be performed on sidewalls that terminate at the regulatory limit of the HWMUs or on HWMU sidewalls that are scheduled to be excavated deeper than the exposed sidewall in question. The numbers of sidewall screening locations for each HWMU are shown on Sheet 6. A random number generator will be used to determine which nodes of each 10-foot by 10-foot grid will be screened.

Samples for XRF analysis will be collected utilizing decontaminated or disposable sampling equipment from a depth interval of 0-6 inches below the bottom of the excavation. The samples will be placed into separate clean plastic baggies and homogenized by hand (protected by a clean glove) for approximately 1 minute. After homogenization the XRF will be utilized to analyze the sample for lead, arsenic, antimony, cadmium and selenium, in accordance with the USEPA's SW-846, Method 6200. Five readings will be taken from each sample and recorded in the fieldbook and the results averaged to provide the uncorrected representative concentration. A minimum of 20 percent of the soil samples will be submitted to the Quality Assurance Analytical Laboratory for total lead analysis. The laboratory results will be evaluated against the corresponding average XRF concentration and a correction factor (regression equation) will be developed for each parameter. The correction factor will be applied to those XRF sample results without a corresponding laboratory result. Utilizing the available laboratory results and the corrected average results for each sample, the 95% UCL for each remediation area will be calculated and compared against the soil standards listed in the CM Design Report. If the 95% UCL is less than the soil standards then the excavation area will be deemed complete. If the 95% UCL is greater than the soil standards then additional excavation will be performed within portions of the excavation area as designated by the QA Representative. The amount of additional removal will be determined by the QA Representative based on the observed sampling results and visual conditions within the excavation. After re-excavation the remediated portions will be resampled at locations approximating the locations of the previous samples and analyzed with the XRF following the same protocol described above. The average XRF result will be corrected using the correction factor and the 95% UCL recalculated. This process shall be repeated until acceptable results are achieved.

If distinct layers or pockets of slag or battery casing materials are observed in the bottom or sidewalls of the excavation area, the QA Representative will require selective removal of the identified material.

APPENDIX B
EARTHWORK

DRAFT
Pre-Final CM Design
Refined Metals Corporation
Beech Grove, Indiana
April ___, 2010

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1.0 INTRODUCTION

1.1 TERMS OF REFERENCE

1.1.1 Purpose

This appended section of the Construction Quality Assurance Plan (CQAP) addresses quality assurance requirements for earthwork operations during implementation of the Corrective Measures at the RMC facility Beech Grove, Indiana. The appendix details construction monitoring activities, soil sampling, soil testing and documentation.

1.1.2 References

ASTM D 421 Test Method for Dry Preparation for Soil Samples for Particle-Size Analysis and Determination of Soil Constants.

ASTM D 422 Test Method for Particle-Size Analysis of Soils

ASTM D 698 Test Method for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using a 5.5-lb (249-kg) Rammer and 12-inch (305-mm) Drop.

ASTM D 1556 Test Method for Density of Soil In Place by the Sand-Cone Method

ASTM D 1557 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop

ASTM D 2487 Test Method for Classification of Soils for Engineering Purposes

ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	Test Method for Water Content of Soil and Rock In Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 MEETINGS

To maintain a high degree of quality during earthwork operations, open channels of communication are required. Project Progress Meetings will be conducted as required by Specification Section 01200.

2.0 SOIL EVALUATION

The Contractor will provide as a pre-construction submittal laboratory analytical and geotechnical results for each of the proposed off-site soil and topsoil borrow sources proposed for use on this project. The soil evaluation shall be repeated each time a material variation is noted by the QA Representative in the field and for each new borrow source. The Contractor shall submit the samples to an independent laboratory for the following test:

GEOTECHNICAL PROPERTIES

Property	Test Method	Required Value
Gradation	ASTM D 422	Between 10% and 40% passing #200 sieve
Plasticity	ASTM D 4318	
Unified Soil Classification	ASTM D 2487	Sandy loam, loam, sandy clay loam, silty clay loam, loamy sand or silt loam
Modified Proctor Compaction	ASTM D 1557	
Atterberg Limits	ASTM D 423 and D 424	PI ≤20, LL ≤40

Note: Modified Proctor Compaction Analysis is not required for propose topsoil sources.

ANALYTICAL TESTING

Analyte	Method
Total Petroleum Hydrocarbons	EPA 1664A
Total Organic Halogens (TOX)	SW-846 9020B
Priority Pollutant Metals	SW-846 6010B/7471B

Priority Pollutant Pesticides/PCBs	SW-846 8081B/8082A
Priority Pollutant VOCs	SW-846 8260B
Priority Pollutant SVOCs	SW-846 8270C

Soil fill sources may not be from off-site industrial property borrow source. Quarry sources for aggregate and sand materials must be identified before the project begins and state-permitted borrow quarries are required.

Material which does not meet the project specifications and satisfaction of RMC shall not be used at the site. The QA representative, in consultation with the CM Engineer shall determine the acceptability of soil fill material with respect to the project specifications (Section 02210).

3.0 PLACEMENT AND COMPACTION

3.1 WEATHER CONDITIONS

Placement of soil fill shall be suspended if climatic conditions are inappropriate, as determined by the QA Representative. Precipitation and cold weather may prohibit fill placement. Soil fill shall not be placed when the material to be placed or the surface of the material in-place is frozen or wet.

3.2 FOUNDATION PREPARATION

Areas which are to receive soil fill shall be proofrolled prior to soil placement. Areas with free or standing water are to be considered unacceptable. Areas which exhibit excessive pumping or yielding shall be reworked and recompacted or undercut and replaced. The Contractor is responsible for the subrgade condition. The QA Representative shall determine and document the acceptability of soil fill areas.

3.3 FILL PLACEMENT

All cap soil fill shall be placed to the lines and grades shown on the project drawings. Survey controls required for earthwork placement shall be established by a professional surveyor. Controls shall be established based upon the vertical and horizontal reference system develop by the Contractor's Surveyor prior to soil remediation activities.

The QA Representative shall observe soil placement. Vegetation, organic matter, trash, debris, oversized stones or other unsuitable materials shall be removed from the fill soil. Imported soil fill with excessive quantities of deleterious material, as determined by the QA Representative, shall be removed from the site. Soil fill shall be placed in lifts with a loose lift thickness of 12 inches or less.

Successive layers of fill may not be placed until the preceding fill layer has been properly compacted, as determined by the QA Representative.

The QA Representative shall visually monitor the soil as delivered to the site. The QA Representative shall assure that the soil color, texture, consistency, gradation and plasticity are in accordance with the material accepted during the pre-construction evaluation. The QA Representative may require that the Contractor collect and re-analyze material samples to assure that the fill soil conforms with the project specifications and that the fill soil is the same material accepted by the pre-construction evaluation.

Fill soil samples shall be obtained by the Contractor at the frequency indicated below or whenever a variation in the fill material is observed. Samples shall be submitted to an independent laboratory to determine the following properties:

Property	Test Method	Frequency
Gradation	ASTM D 422	3,000 CY
Atterberg Limits	ASTM D 423 and 424	3,000 CY
Plasticity	ASTM D 4318	3,000 CY
Unified Soil Classification	ASTM D 2487	3,000 CY
Modified Proctor Compaction	ASTM D 1557	3,000 CY
Analytical Testing	(see Section 2.0)	5,000 CY (off-site)

Samples which have gradation, plasticity and material classification properties which vary significantly from those determined during the soil evaluation shall be re-tested. The QA Representative shall determine the necessity for shear strength testing. Imported material which does not meet the project specifications shall be removed from the site. The QA Representative shall determine the acceptability of soil fill material with respect to the project specifications. Any discrepancies or questions shall be clarified with the CM Engineer.

The Earthwork Contractor is responsible for maintaining and protecting fill areas from damage until final completion of the project. Travel over fill areas shall be restricted to prevent rutting or other degradation. Completed fill areas that are damaged following placement shall be scarified, filled and re-compacted to the satisfaction of the QA Representative.

3.4 COMPACTION

Compaction shall be observed by the QA Representative. The QA Representative shall observe the compaction equipment, number of passes and completeness of coverage. Soil fill shall be compacted to at least 92% of the maximum dry density as determined by the modified Proctor test, ASTM D 1557. In addition to the compaction requirement, Cap Soil Fill shall have a moisture content ranging from -5% to +3% of the optimum.

The compaction characteristics for fill soils shall be determined by an independent laboratory retained by the Contractor. A sample shall be collected by the Contractor once for every 3,000 CY or when a significant material variation is noted. The compaction characteristics shall be determined, including maximum dry density and optimum moisture content, according to ASTM D 1557. The resultant information will establish field compaction criteria.

The QA Representative shall determine the acceptability of soil compaction. Evaluation shall be based upon visual observation of material stability and in-place density testing. In-place density testing shall be performed by the Contractor's Quality Control representative by nuclear density methods, ASTM D 2922 and D 3017, at a frequency of once for every 1,000 SF placed and once per lift. If nuclear density methods are determined to be inappropriate, in-place density shall be determined according to ASTM D 1556. In-place density results must be included with daily project reports. Any soil reworking and re-compaction, as determined by the QA Representative, shall be performed by the Contractor.

3.5 ANCHOR TRENCH

The Contractor shall excavate and backfill the anchor trench for the cap systems geosynthetics and anchor trench drain according to the project specifications and quality assurance procedures outlined in the accompanying Construction Quality Assurance Plan for Geosynthetic Lining System Installation. The QA Representative shall observe anchor trench construction and backfilling.

4.0 EARTHWORK ACCEPTANCE

4.1 CONTRACTOR

The Contractor retains all ownership for the soil fill until accepted by the RMC. The Contractor remains responsible for the condition of the soil subbase until the geosynthetic lining system is installed.

4.2 RMC

RMC will accept soil fill when:

1. Soil evaluation testing is complete and the soil fill has been shown to meet project specifications.

2. Placement and compaction is completed.

3. In-place density results, daily field reports and compaction test data have been submitted.

4. As-built drawings, sealed by a registered Professional Surveyor, have been received by the Owner. As-built drawings should show elevations of the starting ground surface, bottom of excavations, restored ground surface, bottom of containment cell, top of waste in containment cell and top of cap.

APPENDIX C
GEOSYNTHETICS INSTALLATION

Pre-Final CM Design
Refined Metals Corporation
Beech Grove, Indiana
April 12, 2010

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LIST OF FORMS

1.0 INTRODUCTION

1.1 TERMS OF REFERENCE

1.1.1 Purpose

This manual addresses the Quality Assurance and Quality Control of the installation of high density polyethylene (HDPE) geomembrane and composite drainage net for Refined Metals Corporation Beech Grove (RMC). The manual delineates the quality procedures and standards required for production and installation.

For purposes of this document, the term "geomembrane" refers to the 60 mil textured HDPE geomembrane layer of the proposed containment cell cap as described in Section 02755 of the Specifications. The term "composite drainage layer" net shall mean the double side drainage layer as described in Section 02751 of the Specifications.

1.1.2 Quality Assurance

Quality Assurance is defined as a planned and systematic pattern of all means and actions designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service. This section also provides a methodology for resolving problems which may occur during construction.

1.1.3 Quality Control

Quality Control is defined as those actions which provide a means to measure and regulate the characteristics of an item or service in accordance with contractual and regulatory requirements.

1.1.4 References

ASTM D 570	Test Method for Water Absorption of Plastics
ASTM D 638	Test Method for Tensile Properties of Plastics
ASTM D 746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 792	Test Method for Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 882	Test Method for Properties of Plastic Sheeting
ASTM D 1004	Test Method for Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1204	Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM D 1238	Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1505	Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D 1603	Test Method for Carbon Black in Olefin Plastics
ASTM D 1682	Test Method for Strip Tensile Strength
ASTM D 1693	Test Method for Environmental Stress Cracking of Ethylene Plastics
ASTM D 2663	Test Method for Rubber Compounds-Dispersion of Carbon Black
ASTM D 3015	Test Method for Microscopical Examination of Pigment Dispersion in Plastic Compounds
ASTM D 4354	Standard Practice for Sampling of Geosynthetics for Testing
ASTM D 4437	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
ASTM D 4533	Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D 4595	Test Method for Tensile Properties of Geotextiles by Wide Width Strip
ASTM D 4632	Test Method for Breaking Load and Elongation of Geotextile (Grab Method)

ASTM D 4716	Test Method for Constant Head Hydraulic Transmissivity of Geotextiles and Geotextile Related Products
ASTM D 4759	Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D 4833	Test Method for Index Puncture of Geotextiles, Geomembranes and Related Products
ASTM D 5084	Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5321	Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosnythetic Friction by the Direct Sheer Method.

GRI Test Method GM6 - Pressurized Air Channel Test for Dual Seamed Geomembranes

NSF Standard 54 (1991 or current) Flexible Membrane Liners

2.0 GEOSYNTHETIC MANUFACTURING AND TRANSPORTATION

2.1 GEOSYNTHETIC PROPERTIES CERTIFICATION

2.1.1 Geomembrane Raw Material

The geomembrane manufacturer is responsible for the production of geomembrane rolls from resin.

Upon delivery, the following shall be furnished by the Manufacturer:

1. Reports on tests performed by the Manufacturer to verify the quality of the resin used in the geomembrane rolls proposed for use on the project. The tests should include the following:

Required Material Properties for HDPE

TEST	METHOD	NOTES	REQUIREMENTS
SPECIFIC GRAVITY (1)	ASTM D 792 OR D 1505	1 and 2	≥0.940
CARBON BLACK CONTENT	ASTM D 1603	2	2 to 3%
MELT INDEX	ASTM D 1238 (Condition E MAX)	1 and 2	0.3 g per 10 minutes

(1) Measure prior to adding carbon black.
(2) 1 per 50,000 square feet of 1 per resin batch whichever results in a more number of tests.

2.1.2 Geomembrane

The Installer shall submit certification that all geomembrane rolls brought to the site meet the following requirements or the Manufacturers minimum published values, whichever is more restrictive. Adherence to this requirement shall be made a condition of the material purchase order.

Required Material Properties for 60 mil Textured HDPE Geomembrane

PROPERTY	TEST METHOD	TYPICAL VALUE
Thickness, mils, Minimum 1. Overall	ASTM D1593	57
Density (g/cc), minimum	ASTM D 792 or D1505	0.94
Tensile Properties	ASTM D638-NSF Modified	
1. Strength at Yield (lb/in width), minimum		126
2. Strength at Break (lb/in width), minimum		90
3. Elongation at Yield (percent), minimum		12
4. Elongation at Break (percent), minimum		100
Tear Resistance (lb) minimum	ASTM D1004	39
Low Temperature Brittleness (°C), maximum	ASTM D 746	-60
Dimensional Stability, Percent Change, Maximum	ASTM D 1204 100°C, 1 hr	+/-2.0
Environmental Stress Crack (hrs) minimum	ASTM D1693-NSF Modified	1500
Puncture Resistance, lbs., Minimum	ASTM D4833	72
Carbon Black Content (%), range	ASTM D 1603	2.0 - 3.0
Carbon Black Dispersion	ASTM D3015-NSF Modified	A1, A2

For each geosynthetic material used at the site, the Installer shall provide the following to the QA Representative:

1. A properties sheet including specified properties and testing methods.
2. A certification that property values given in the properties sheet are guaranteed by the Manufacturer.
3. Geosynthetic delivery, storage, and handling instructions.
4. One quality control certificate for every roll of geomembrane. This certificate shall include roll numbers and identification. The finished rolls shall be identified by a number corresponding to the particular batch of resin used.

The following information shall also be provided by the Installer for any extrudate used for the project.

1. Certification stating that all extrudate is from the same Manufacturer and is of the same resin type as the geomembrane seamed.
2. Copy of quality control certificates issued by the Manufacturer

2.1.3 Geotextile

The Installer shall submit certification that geotextile rolls for use in the interior edge drain and liner system meet the following requirements or the Manufacturers minimum published values, whichever is more restrictive. Adherence to this requirement shall be made a condition of the material purchase order:

Required Material Properties of Geotextile for Interior Edge Drain

Properties	Test Method	Required Value
Grab Strength (lbs.), min.	ASTM D 4632	150
Puncture Resistance (lbs.), min.	ASTM D 4833	75
Tear Strength (lbs.), min.	ASTM D 4533	70
Mass per Unit Area (oz/sy), min.	ASTM D 3776	8
Apparent Opening Size (US Sieve No.)	ASTM D 4751	80

The Installer shall provide the QA Representative with a copy of geotextile manufacturer's recommended installation procedures to be followed during geotextile installation.

2.1.4 Geonet (Geocomposite)

The Installer shall submit certification that all geonet rolls brought to the site meet the following requirements or the minimum published values, whichever is more restrictive. Adherence to this requirement shall be made a condition of the material purchase order:

Required Material Properties of HDPE Geonet

Properties	Test Method	Required Value
Transmissivity (M^2/S), min.	ASTM D 4716 $i = 0.1$ $\sigma = 10{,}000$ psf	2×10^{-4}
Tensile Strength (lb/in), min.	ASTM D 1682 or D 4595	30

2.1.5 Interface Friction

The Contractor shall test geosynthetic and soil layers by shear box testing (ASTM D 5321) to demonstrate the following minimum values are met:

Representative sample of site soil to Textured Geomembrane	22°
Nonwoven Geotextile (Geocomposite) to Textured Geomembrane	22°
Nonwoven Geotextile (Geocomposite) to Proposed Cap Soil	22°

2.2 TRANSPORTATION AND HAULING

Geosynthetic rolls or panels shall be packaged and shipped by appropriate means so that no damage is caused. Transportation shall be the responsibility of the Installer.

2.2.1 Delivery

Off-loading and storage of the geosynthetics is the responsibility of the Installer. The Installer shall be responsible for replacing any damaged or unacceptable material at no cost to RMC. No off-loading shall be done unless the QA Representative is present. Any damage occurring during the off-loading shall be documented by the Installer and QA Representative. All damaged rolls shall be separated from undamaged rolls and stored at locations designated by the QA Representative until Installer can remove damaged materials from the site. The QA Representative will be the final authority on determination of damage. All unacceptable materials shall be removed from the site by the Installer.

The QA Representative shall visually inspect the surface of all rolls for defects and/or damage, unrolling only if necessary. Any flaws shall be immediately reported and documented.

The Installer shall take care that any equipment used in handling the geomembrane does not cause damage during the off-loading process. Appropriate handling equipment includes cloth chokers and spreader bars for loading, spreader and roll bars for deployment. Dragging panels on ground surfaces shall not be permitted. The Installer shall also assure that all personnel handle the geomembrane with care, so as not to damage the material. Geomembrane material shall not be folded; folded material shall be rejected.

Form 1 shows an example of a Material Delivery Report to be completed by the QA Representative.

2.2.2 On-Site Storage

Storage of geosynthetics shall protect them from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or any other damage.

Storage space shall be near the site to be lined, to minimize additional handling. It shall be protected against theft, vandalism, passing vehicles, and any other hazards.

Geosynthetic rolls shall be stored on prepared surface, i.e., a smooth surface without obstructions and/or debris, (not on wooden pallets). Geosynthetic rolls may be stacked per Manufacturers recommendations but no more than three rolls high.

2.3 MATERIAL CONFORMANCE

Independent material conformance testing is not required. The Installer shall submit certifications from the geosynthetic manufacturers that the material delivered to the site meet the requirements established in this CQAP and the Specifications. Geosynthetic materials may not be used until conformance certifications are received and approved by the QA Representative.

The QA Representative shall determine the acceptability of geosynthetic components. Determinations regarding the acceptability of materials not meeting the specifications can only be made by the Engineer.

3.0 GEOMEMBRANE INSTALLATION

3.1 EARTHWORK

Immediately prior to installation of the designed geosynthetic components of the cap system, the subbase surface shall be observed by the QA Representative and Installer. The decision to repair ruts or depressions, if any, shall be made by the QA Representative and Installer. The Contractor shall repair any unacceptable subbase.

All recommendations and work performed on the subbase prior to installation shall be recorded.

No liner shall be placed on surfaces not previously found acceptable to the QA Representative and Installer. If requested, the Installer must also provide USEPA and/or IDEM an opportunity to inspect the subbase prior to geosynthetic placement.

The Contractor shall be responsible for preparing and maintaining the subbase in a condition suitable for installation of the liner unless specifically agreed otherwise. Contractor responsibilities include:

1. Surfaces to be lined shall be smooth, and free of debris, roots, and angular or sharp stones larger than 2-inches. The subbase shall be compacted in accordance with the design specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the subbase without causing rutting. The subbase shall have no sudden or abrupt changes in grade.

2. Protection of the subbase from erosion and water ponding. Protection, if required, may consist of a thin plastic protective cover (or other material as approved by the

QA Representative) installed over the completed subbase until such time as the placement of liner begins. The plastic sheeting must be removed prior to geosythetic deployment as the presence of the plastic may cause interface sliding or failure.

3. Cap anchor trench excavation and preparation.

4. All earthwork operations as detailed in the design specifications. Earthwork quality assurance shall also be performed in accordance with the Construction Quality Assurance Plan for Earthwork.

3.2 ANCHOR TRENCH

3.2.1 Excavation

The cap anchor trench shall be excavated to the line, grade, and width shown on the construction drawings, prior to cap system geosynthetic placement. The QA Representative shall verify that the anchor trench has been constructed according to the project drawings. The anchor trench shall be excavated by the Contractor. If anchor trench is excavated in a clayey soil susceptible to desiccation, no more than the amount of trench required for the lining system to be anchored in one day shall be excavated to minimize desiccation potential of the anchor trench clay soils. Rounded corners shall be provided in and at the top of the trench so as to avoid sharp bends in the geomembrane.

3.2.2 Backfilling

The anchor trench shall be adequately drained to prevent ponding or otherwise softening of the adjacent soils while the trench is open. The anchor trench shall be backfilled by the Earthwork Contractor as outlined in the project specifications. Care should be taken when backfilling the trenches to prevent any damage to the cap geosynthetics or drainage pipe. If damage occurs, it shall be repaired by the Installer prior to the completion of the backfill.

3.3 WEATHER CONDITIONS

Welding shall not take place during any precipitation, in the presence of excessive moisture i.e., fog, dew, frost, in areas of ponded water or in presence of excessive winds, (unless wind barriers are provided).

Seaming may proceed if the geomembrane sheet temperature is above 32°F (0°C), or if it can be proven via test strips that good seams can be fabricated at lower temperatures. The QA Representative shall determine the acceptability of cold weather seaming.

Seaming may proceed if the sheet temperature is below 122°F (50°C), or if it can be proven via test strips that quality seams can be fabricated at higher temperatures. The QA Representative shall determine the acceptability of hot weather seaming. Sheet temperature should be measured by an infrared thermometer or surface contact thermocouple.

3.4 METHOD OF PLACEMENT

3.4.1 Installer Responsibility

The Installer shall be responsible for the following:

1. No equipment or tools shall damage the geosynthetic by handling, trafficking, or other means.

2. No personnel working on the lining system shall smoke, wear damaging shoes, or engage in other activities that could damage the geosynthetics.

3. The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil.

4. The method used to place geomembrane panels shall minimize wrinkles. Wrinkles shall be identified as to proper location by the Installer and shall be shown on the Installer's as-built drawings. Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

5. Bridging shall be removed, unless accepted by the QA Representative.

6. Adequate loading (i.e., sandbags) shall be placed to prevent uplift by wind. (In case of high winds, continuous loading is recommended along the edges of panels to minimize risk of wind flow under the panels).

7. Direct contact with the geomembrane shall be minimized, i.e., the geomembrane in traffic areas is to be protected by geotextiles, extra geomembrane, or other materials approved by the QA Representative.

8. Panels shall not be skewed from the vertical unless presented in the panel layout plan and approved by the CM Engineer.

3.4.2 Field Panel Identification

A field panel is the unit area of geomembrane which is to be seamed in the field, i.e., a field panel is a roll or a portion of a roll cut in the field. Each field panel shall be given an "identification code" consistent with the layout plan. This code shall be as simple and logical as possible.

3.4.3 Field Panel Placement

Field panels are installed at the locations indicated by the layout plan. Field panels may be installed in either way:

1. All field panels are placed prior to field seaming. No more panels may be placed than can be seamed by the end of the day.

2. Field panel are placed one at a time, and each panel is seamed immediately after its placement (in order to minimize the number of unseamed field panels).

Each panel placement should be recorded immediately using the daily deployment report. Identification code, location and date shall be recorded. Form 2 is used as a record of daily deployment. Form 2 shall be completed by the QA Representative. All panels that are folded shall be replaced by the Installer.

3.5 FIELD SEAMING

3.5.1 Procedures

The welding or seaming procedure consists of overlapping the two geomembrane sheets such that any liquid flowing across the seams would flow from the top panel to underlying panel.

Seams shall be oriented parallel to the slope, i.e., oriented along, not across the slope. In corners and odd shaped geometric locations, the number of field seams should be minimized.

Seams shall be aligned with the least possible number of wrinkles and "fishmouths." If a "fishmouth" or wrinkle is found, it shall be cut, removed and patched.

Personnel performing field seaming shall meet the following requirements:

1. Master Seamer Qualifications: The Master Seamer shall have completed a minimum of 500,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for use on this project.

2. Other Seamer Qualifications: Other seamers shall have seamed a minimum of 100,000 square feet of geomembrane.

3. The Master Seamer shall provide direct supervision over other seamers.

Details of each seam, including seamer, machine number, time, and temperature shall be recorded by the QA Representative on the Pre-Weld and Geomembrane Seaming Record (Form 4).

3.5.2 Pre-Weld/Trial Weld

Pre-welds or trial welds shall be taken to verify the performance of welding equipment, seaming methods, and conditions. No seaming equipment or seamer shall be allowed to perform production welds until equipment and seamers have successfully completed trial weld(s). Pre-welds should be made in the same surroundings and environmental conditions as the production welds, i.e., in contact with the subgrade. Pre-welds shall be performed at the following frequency:

1. At all start-ups and prior to planned shut-downs.
2. Throughout the day as equipment requires start-up after a breakdown.

Samples should be at least 3 feet long and 1 foot wide with the seam centered lengthwise. (Typically the samples are made by the welder seaming two piece of the geomembrane together). Ten one-inch wide strips should be cut from the trial weld.

Specimens should be quantitatively tested by the Installer for peel adhesion for bonded seam strength (shear) using a recently calibrated field tensiometer. A specimen is considered to pass when the test results are consistent with test requirements established in Section 3.7.

A trial weld sample shall be considered passing if at least eight specimens pass peel and shear tests. Five shall be tested in peel mode and five in sheer mode.

Repeat the trial weld in its entirety when any of the trial weld samples fail in either peel or shear. When repeating trial welds fail, seaming apparatus and seamer shall not be used for production welding until deficiencies or conditions are corrected and two consecutive successful trial welds are achieved.

All trial welds shall be recorded by the QA Representative on Form 3 (Pre-Weld and Geomembrane Seaming Record).

3.5.3 Equipment

Hot dual wedge welders and hand held extrusion welders are the pieces of equipment approved for field seaming. The Installer is expected to utilize the dual wedge welder to the maximum extent possible and utilize the hand held extrusion welder for patches and finishing work.

Hot Wedge Welding

Consists of placing a heated wedge, mounted on a self propelled vehicular unit, between 2 overlapping sheets which are heated above the polyethylene's melting point. After being heated by the wedge, the overlapping panels pass through a set of preset pressure wheels which compress the panels together to create a fusion weld. A dual track wedge welder will create two fusion welds separated by an unwelded channel.

The double wedge fusion welder shall be equipped with a temperature readout device which continuously monitors the temperature of the wedge.

Other equipment used during seam operations includes field tensiometer, rotary grinders, electric generators, coupon die and press and manometers/air pumps.

A recently calibrated field tensiometer shall be used for sheer and peel testing. The device shall have a load range of 0 to 500 pounds, a peak hold function and digital readout. Speed settings or 2" or 20" per minute shall be available.

Properly functioning portable electric generators must be available within close proximity of the seaming region and with adequate extension cords to complete the entire seam. These generators should be of sufficient size or numbers to handle all seaming electrical requirements. The generator must have rubber tires, be placed on a smooth plate such that it is completely stable that no damage can occur to the geomembrane or to the underlying liner or subgrade material. Fuel (gasoline or diesel) for the generator must be stored away from the geomembrane and if accidently spilled on the geomembrane must be immediately removed. The area should be inspected for damage to the geomembrane and repaired if necessary.

If applicable, manometers for testing air channel welds provided with a heavy duty needle or other approved pressure feed device, an air pump shall be provided. Two manometers shall be used in the Air-Pressure test.

A coupon die and press shall be supplied for cutting peel and shear specimens for trial seaming.

3.5.4 Seam Preparation

For wedge welding, seam preparation shall include:

1. The panels of the geomembrane shall be overlapped at least four-inches.

2. The seam area shall be cleaned prior to seaming to assure the area is clean and free of moisture, dust, dirt and debris of any kind. No grinding is required for fusion welding.

3. The panels shall be adjusted so that seams are aligned with the fewest possible number of wrinkles and "fishmouths."

4. A moveable protective layer may be used directly below the overlap of geomembrane that is to be seamed to prevent build-up of moisture between the panels.

3.6 NON-DESTRUCTIVE SEAM TESTING

Purpose of non-destructive testing is to check the continuity of the seam. The Installer shall non-destructively test all field seams over their full length. All test equipment shall be furnished by the Installer.

3.6.1 Vacuum Box Testing

Equipment for vacuum box testing shall consist of the following:

1. A vacuum box assembly consisting of a rigid housing, a transport viewing window, a soft neoprene or rubber gasket attached to the bottom, a valve assembly, and a vacuum gauge.

2. A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections.

3. A rubber pressure/vacuum hose with fittings and connections.

4. A plastic bucket and wide brush (or spray assembly).

5. A soapy solution.

The following procedure shall be used by the Installer:

1. Excess sheet overlap (if any) shall be trimmed away.

2. The window and gasket surfaces shall be cleaned and checked for leaks.

3. The vacuum pump shall be energized and the tank pressure shall be reduced to approximately 5 psi.

4. A strip of the geomembrane shall be wetted approximately 12 inches by 48 inches (length of the box) with a soapy solution. Size of the wet area depends on the size of the vacuum box.

3. The box shall be placed over the wetted area and compressed. Steel reinforcement that comes in contact with the liner shall not have any burs, sharp points, etc.

4. The bleed valve shall be closed and the vacuum valve shall be opened.

5. It shall be verified that a tight seal is created.

6. For a period of approximately 15 to 30 seconds, the geomembrane shall be examined through the viewing window for the presence of soap bubbles.

7. If no bubbles appear, the vacuum valve shall be closed, the bleed valve shall be opened, and the box shall be moved to the adjoining area with a minimum of 3 inches overlap. The process shall then be repeated.

8. All areas where soap bubbles appear shall be marked and repaired and then retested.

9. Vacuum box results should be recorded by the QA Representative on the Non-Destructive Seam Testing Form (Form 4). All vacuum box test shall be observed by the QA Representative.

3.6.2 <u>Air-Pressure Testing</u>

Air pressure testing is applicable to those processes which produce a double seam with an enclosed space. This method should be used by the Installer rather than vacuum box testing, to the maximum extent possible.

Equipment for testing air-pressure testing shall include:

1. An air pump equipped with a pressure gauge capable of generating and sustaining a pressure between 25 to 30 psi and mounted on a cushion to protect the geomembrane. The air pump may be manual or motor driven.

2. A manometer equipped with a sharp hollow needle, or other approved pressure feed device.

The following procedures shall be followed by the Installer:

1. Both ends of the seam area to be tested shall be sealed.

2. A manometer or other approved pressure gauge shall be inserted into both ends of the channel created by the double wedge or extrusion double wedge fusion welds. Means of pressurizing must be provided.

3. The air pump shall be energized to verify the unobstructed passage of air through the channel. The QA Representative shall verify unobstructed air flow.

4. The air pump shall be energized to pressure between 25 and 30 psi, the valve shall be closed, and the pressure shall be sustained for 5 minutes.

5. If there is a loss of pressure exceeding 4 psi, or the pressure does not stabilize, the faulty area shall be located, repaired, and retested.

6. The needle or other approved pressure feed device shall be removed and the hole sealed. The air channel at the other end shall be opened to insure that air pressurized the entire channel prior to removing the feed device.

7. Test results shall be recorded by the QA Repersentative on the Non-Destructive Air Pressure Seam Testing Summary (Form 4).

3.7 DESTRUCTIVE SEAM TESTING

Purpose of destructive testing is to determine and evaluate seem integrity and assess long-term performance.

3.7.1 Location and Frequency

The Installer shall provide the QA Representative with minimum of one destructive test sample per 500 feet of seam length from a location specified by the QA Representative; individual samples may be taken at greater or lesser intervals.

Additional destructive tests may be taken in areas of contamination, offset welds, visible crystallinity or other potential cause of faulty welds, as determined by the QA Representative.

The seaming technician (or Installer) shall not be informed in advance of the locations where the seam samples will be taken.

3.7.2 Sampling Procedure

In order to obtain test results prior to completion of liner installation, samples shall be cut by the Installer as seam progresses at the locations designated by the QA Representative.

The Installer shall mark all samples with the date and seam sample number. The Installer should also record, the date, location, time, and seam number for each specimen taken.

All holes in the geomembrane resulting from obtaining the seam samples shall be immediately repaired. All patches shall be vacuum tested. Sample locations should be located on the as-built drawing. All destructive seam samples shall be recorded by the QA Representative on the Destructive Sample Record (Form 5). Information to be recorded includes date, sample number, seam number, machine number, seamer, date sent to lab and a summary of any field test performed.

3.7.3 Size of Samples

The samples shall be 18 inches wide by 36 inches long with the seam centered lengthwise. This sample is usually cut in thirds, two pieces given to the QA Representative and the other given to the liner Installer. The QA Representative shall send one sample to an independent laboratory for testing. The other sample will be archived by the QA Representative in the event future testing is required.

3.7.4 Seam Testing Requirements

Destructive testing involves two techniques: Shear strength and peel adhesion. Destructive testing will be conducted by the Installer and QA Representative.

Shear testing will be performed in accordance with ASTM D 4437-NSF modified. This test involves placing a tensile stress from the top sheet through the weld and into the bottom sheet. Peel testing shall be performed in accordance with ASTM D 4437-NSF modified. This test involves peeling the sheets apart to observe how separation occurs. Results indicate whether or not the sheets are continuously and homogeneously connected through the seam.

Ten 1-inch wide replicate specimens shall be cut from the sample. Five specimens shall be tested for shear strength and five for peel adhesion. The test seam area will be considered acceptable if four of the five samples for each test fail outside of the seam area, provided all five samples must meet the following strength requirements:

SEAM PROPERTIES FOR 60 MIL TEXTURED HDPE GEOMEMBRANE

TEST	TEST METHOD	FAILURE CRITERIA
Shear Strength	ASTM D4437-NSF Modified	120 lb/in (minimum), FTB, greater than 100% elongation
Peel Adhesion	ASTM D4437-NSF Modified	78 lb/in minimum, FTB, less than 10% separation

3.7.5 Independent Laboratory Testing

The QA Representative shall package and ship to the independent laboratory, one section of every seam sample taken for third party determination of seam integrity. The samples shall be tested in accordance with the seam testing requirements. Discrepancies between project seam requirements and Manufacturer's requirements will be handled by adopting the most stringent requirement.

3.7.6 Procedures for Destructive Test Failure

One of the following procedures shall apply whenever a sample fails a field destructive test:

1. The Installer shall cap strip the seam between the failed location and any passed test location.

2. At the QA Representative discretion, the Installer can retrace the welding path to an intermediate location (at a minimum of 10 feet from the location of the failed test), and take a sample for an additional destructive seam test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, the process is repeated.

3. Over the length of seam failure, the contractor shall either cut out the old seam, reposition the panel and reseam, if possible, or add cap strip, as required by the QA Representative.

The QA Representative shall document all actions taken in conjunction with destructive test failures.

3.8 DEFECTS AND REPAIRS

3.8.1 Identification

All seams and the entire geomembrane surface shall be observed by the QA Representative for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Unacceptable panels shall be removed and replaced. Because light reflected by the geomembrane helps detect defects, the surface of the geomembrane shall be clean at the time of observation. Reflecting light will cause the surface of the geomembrane, at locations where there are imperfections, to appear white or light in color. The geomembrane surface shall be brushed, blown, or washed by the Installer if the amount of dust or mud inhibits observation, as determined by the QA Representative.

3.8.2 Evaluation

Any suspect locations shall be non-destructively tested as appropriate in the presence of the QA Representative. Each location that fails the non-destructive testing shall be marked by the QA Representative, and repaired accordingly.

3.8.3 Repair Procedures

Any portion of the geomembrane exhibiting a flaw or failing a destructive or non-destructive test shall be repaired.

1. Defective seams shall be restarted/reseamed as described in these specifications.

2. Long lengths of failed seams shall be capstripped.

3. Tears shall be repaired by patching. Where the tear is on a slope or an area of stress and has a sharp end it must be rounded by cutting prior to patching.

4. Blisters, holes, undispersed raw materials, and contamination by foreign mattery shall be repaired by large patches.

5. Surfaces of the geomembranes which are to be patched shall be cleansed and lystered.

6. Folds shall be removed or patched.

Patches shall be round or oval in shape, made of the same geomembrane, and extended a minimum of 6 inches beyond the edge of defects. All patches shall be the same compound and thickness as the geomembrane specified. All patches shall have their top edge beveled with a grinder prior to placement on the geommembrane. Patches shall be applied using approved methods only.

All surfaces must be clean and dry at the time of repairs. All seaming equipment used in repairs must be approved by the QA Representative and Installer. All repair procedures, materials, and techniques shall be approved in advance of the specific repairs by the QA Representative and Installer.

Form 6 (FML Repair Locations) shall be used by the QA Representative for documenting repairs.

3.8.4 Verification of Repairs

Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved. The QA Representative shall take additional destructive seam samples, as necessary, for long lengths of cap stripped seam.

Recording of results: daily documentation of all non-destructive and destructive tests shall be prepared by the QA Representative. This documentation shall identify all seams that initially fail destructive testing and indicate evidence that these seams were repaired and successfully retested. Documentation shall identify all patch, bead or cap strip locations and indicate that repairs were made and successfully tested.

Repair documentation shall include:

1. Panel and seam location.

2. The type of repair, i.e., patch, bead, cap strip, etc.

3. Identification of any cap strips that are repairs for failing a destructive seam test.

4. Vacuum test results on repairs.

5. Precise location of the repair.

4.0 GEOCOMPOSITE AND GEOTEXTILE INSTALLATION

4.1 HANDLING AND PLACEMENT

The geocomposite (geotextile/geonet/geotextile), geonet and geotextile shall be handled in a manner to ensure it is not damaged. Prior to and during placement, the Installer and QA Representative shall assure that:

1. The portion of the geomembrane to be covered by the composite drainage layer, geonet or geotextile has all required documentation complete.

2. The surface of the geomembrane must not contain stones or excessive dust that could cause damage. Prior to placing the composite drainage layer, the liner shall be swept clean with a soft bristle broom.

3. In the presence of winds, all geosynthetics shall be weighted with sandbags, as necessary. The Installer shall be responsible for damage caused by wind.

4. Geosynthetics shall be cut using an approved cutter, similar to a hooked razor blade. No straight blades are permitted. Care must be taken to protect underlying geomembranes if the geonet or geotextile is being cut in place.

5. Equipment used to deploy the geosynthetics shall not damage the materials or the underlying geomembrane.

6. No personnel working on the lining system shall smoke, wear damaging shoes, or engage in other activities that could damage the geosynthetics.

4.2 INSTALLATION

The Installer and QA Representative shall assure the following during geocomposite, geonet and geotextile seaming:

1. Overlap seams a minimum of six (6") inches.

2. Ties for the geonet are placed at three (3') foot intervals along the seam length. Only nylon ties which do not damage the underlying geomembrane are used; metal ties are not permitted.

3. Tying can be achieved by plastic fasteners. Tying devices shall be white or yellow for easy identification.

4. No horizontal seams are constructed on the side slopes.

5. For the geotextile component of the geocomposite sewing of the geotextile seam may be performed.

4.3 REPAIR PROCEDURES

Patching of the geonet shall be used to repair holes, tears, and defects. Patches shall provide 6" of overlap round the repaired area and shall be held in place with nylon ties. Geonet shall be removed if areas with large defects are observed. The QA Representative shall determine the acceptability of the geonet.

5.0 GEOSYNTHETIC ACCEPTANCE

5.1 INSTALLER

Installer retains all ownership and responsibilities for the geosynthetic until acceptance by the Owner.

5.2 OWNER

The Owner will accept geosynthetic installation when:

1. All required documentation from the Manufacturer and Installer has been received and approved.
2. The installation is complete.
3. Material conformance testing and destructive seam testing is complete.
4. Verification of the adequacy of all field seam and repairs, including associated testing, is complete.
5. Written certification documents, including drawings, sealed by a registered professional Engineer, have been received by RMC.
6. The Installer shall provide a final certification stating the installation has proceeded in accordance with the Specifications.

FORM 1

MATERIAL DELIVERY REPORT

PROJECT NAME: ______________________
PROJECT NUMBER: ______________________
LOCATION: ______________________
DATE: ______________________

MATERIAL TYPE: ______________________

ROLL NO.	BATCH NO.	RESIN TYPE	DESCRIPTION OF DAMAGE

COMMENTS: ______________________

OFF-LOADING PROCEDURES: ______________________

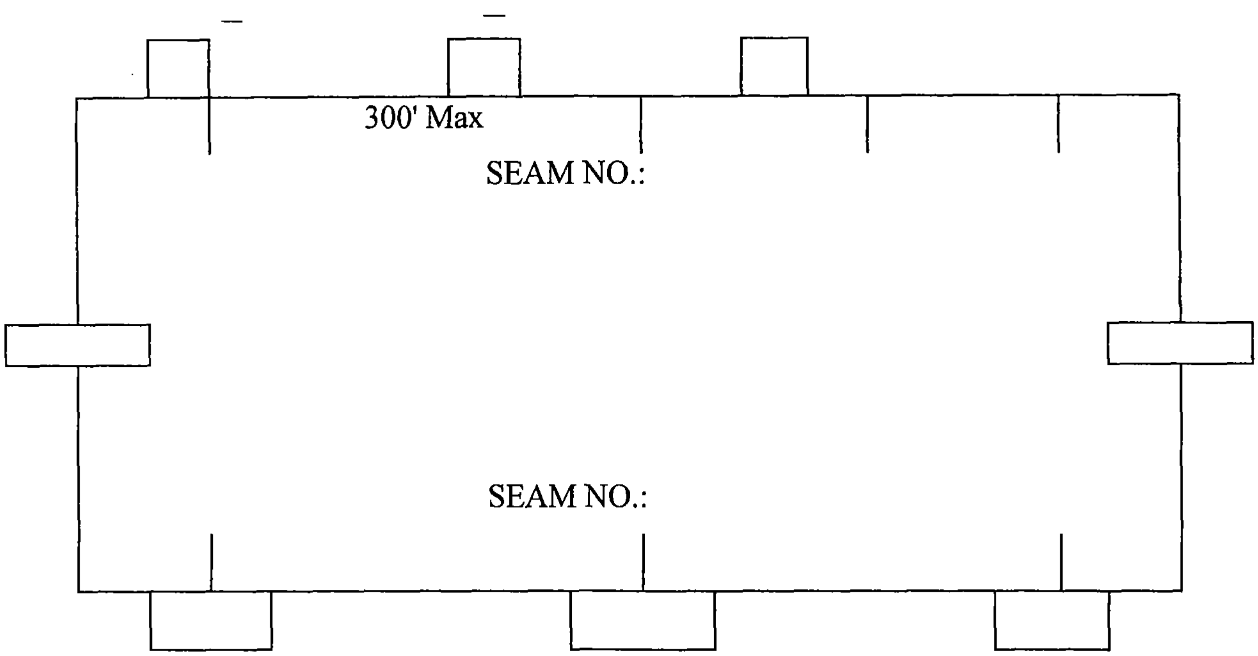
MATERIAL STORAGE: ______________________

FORM 2

GEOMEMBRANE PANEL DEPLOYMENT LOG

PROJECT NAME:____________________ DATE DEPLOYED:__________________
PROJECT NUMBER:__________________ TEMP: Max:________F; Min:_________F
LOCATION:_________________________ WIND:________________ mph N S E W

ALL MEASURED IN MILS



SUB-GRADE ACCEPTED FOR AREA BENEATH PANEL NUMBER:

__________ Yes __________ No

REMEDIAL WORK REQUIRED:

__________ Yes __________ No

TYPE OF WORK REQUIRED: ____

____

____

REMEDIAL WORK COMPLETED AND AREA ACCEPTED:

__________________________ Yes __________ No

COMMENTS: ____

____

____

PANEL NUMBER:_______________
PANEL LENGTH:_______________
ROLL NUMBER:________________

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FORM 3

PRE-WELD AND GEOMEMBRANE SEAMING RECORD

PROJECT NAME: ____________________
PROJECT NUMBER: ____________________
LOCATION: ____________________
DATE: ____________________
QA OFFICIAL: ____________________

WELDING MACHINE NUMBER: __________ WELDER'S NAME: ____________

Pre-weld Seam #	Time am/pm	Temp.	Temperature of		Results		Pass/ Fail*
			Welder	Extrudate	Peel	Shear	

COMMENTS: ____

____

NOTE: USE ONLY ONE FORM PER WELDER.

* PASS OR FAIL RESULTS ARE FOR PRE-WELDS ONLY, TEST RESULTS FOR SEAMS ARE DOCUMENTED ON FORMS 4 AND 5.

FORM 4

NON-DESTRUCTIVE AIR PRESSURE SEAM TESTING

PROJECT NAME:________________________

PROJECT NUMBER:_______________________

LOCATION:______________________________

SEAM NUMBER	CQA	TIME	PSI	DATE	TIME	PSI	PASS/ FAIL *

* REPAIRS OF FAILED SEAMS ARE DOCUMENTED ON FORM 5

** EXTRUSION WELDED

FORM 5

DESTRUCTIVE SAMPLE RECORD

PROJECT NAME: ____________________
PROJECT NUMBER: ________________
LOCATION: ________________

DATE	DS NO.	SEAM NO.	MACH NO.	OPER NAME	FIELD TEST		DATE TO LAB PKG SLIP NO. FEDEX/UPS
					PEEL	SHEAR	

FORM 6

GEOMEMBRANE REPAIR FORM

REPAIR DESIGNATION	DATE DAMAGE OBSERVED	DATE REPAIR CONDUCTED	SIZE	LOCATION OF REPAIR	REPAIRED TEST DATE	RESULT

APPENDIX D
SAMPLING AND ANALYSIS PLAN

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LIST OF TABLES

1.0 INTRODUCTION

The Sampling and Analysis Plan (SAP) presented in this attachment provides the policies, procedures, organization, objectives, functional activities, and specific Quality Assurance/ Quality Control (QA/QC) procedures that shall be employed by Refined Metals Corporation (RMC), Advanced GeoServices Corp. (Advanced GeoServices), and the Remedial Contractor during sampling associated with the proposed corrective Measures for the RMC, Beech Grove, Indiana site to ensure that the technical data generated during the sampling are accurate and representative. A separate SAP specific to groundwater sampling is provided as an attachment to the Inspection and Maintenance Plan.

1.1 SAMPLING AND ANALYSIS PLAN ORGANIZATION

Section 15.0 – Corrective Action

2.0 PROJECT DESCRIPTION

2.1 PROJECT BACKGROUND

The Refined Metals Corporation (RMC) Beech Grove facility (Site) was the location of a secondary lead smelting and refining operation from 1968 through 1995. The general location of the site is shown on Figure 1 of the CM Design Report and a detailed plan of the Site is shown on Sheet 1 of the design drawings. During its operational life, the facility handled hazardous materials or hazardous wastes under the Resource Conservation and Recovery Act (RCRA). These primarily consisted of lead acid automotive and industrial batteries, and lead-bearing materials that were processed for lead recovery.

In accordance with the requirements of RCRA, the facility completed and submitted a RCRA Part A permit application. On November 19, 1980 the facility was granted approval to operate two hazardous waste management units under Interim Status: 1) indoor waste piles; and 2) outdoor waste piles. Facility documents also identify a surface impoundment (lagoon) as a RCRA permitted unit; however, it does not appear to have been included on the Facility Part A permit until after 1991. The Surface Impoundment was, and still is, used to collect and manage facility storm water runoff. See Sheet 1 of the design drawings for the location of the RCRA Hazardous Waste Management Units (HWMUs).

The former indoor and outdoor waste piles were removed when normal facility operations ceased. The site sat idle after December 31, 1995 except for the wastewater treatment system which remained in operation to collect and manage storm water runoff from the lagoon and other site areas. Between August 2009 through early-January 2010 all buildings and structures were decontaminated and demolished, with the exception of four pump houses and the lagoon which were decontaminated, but remain in operation for on-site storm water management. Decontamination and demolition activities were performed in accordance with the *Draft*

Decontamination and Demolition Plan (Advanced GeoServices March 4, 2009) and the *Decontamination and Demolition Implementation Plan* (Focus Contracting, June 8, 2009) both of which were submitted, reviewed and approved by the USEPA and IDEM. A summary report of the decontamination and demolition activities is being prepared on a parallel track with preparation of this CM Design submission and will be included as an attachment to the Corrective Measures Completion Report to be provided following completion of the Corrective Measures.

Throughout the decontamination and demolition process storm water continued to be collected, treated as appropriate, and discharged to the City of Indianapolis POTW. Storm water sampling performed after completion of site cleaning activities has demonstrated that storm water from the lagoon and cleaned surface areas of the site can be discharged without requiring pre-treatment. In an effort to reduce the hydraulic loading on the POTW, the City of Indianapolis has requested that RMC cease discharge of the clean storm water to the sanitary sewer following completion of decontamination and demolition activities. At this time RMC has submitted a request for a "No Exposure Certification for Exclusion from NPDES Storm Water Permitting" to allow surface discharge of the storm water currently sent to the POTW. If storm water currently sent to the POTW will be surface discharged, it will most likely be sent to the drainage ditch at the north end of the property using the existing system of pumps and internal conveyance piping. RMC is also requesting approval from the City of Indianapolis to continue storm water discharge to the POTW until appropriate approvals for surface water discharge can be secured.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The overall responsibility for the project is assigned to Mr. Matthew Love of Exide Technologies, representative of RMC. In this capacity, Mr. Love is responsible for the overall performance of the project including ensuring that the project is conducted in accordance with the Consent Decree and the Corrective Measures (CM) Design Report. This includes confirming that the Contractor, the QA Representative, and the contracted laboratory all conduct its operations in compliance with the CM Design Report. The Information Gathering activities will be performed by Advanced GeoServices, under the direction of RMC. The remedial activities will be performed by a Contractor selected based on cost and qualifications.

Construction Quality Assurance (QA) oversight will be the responsibility of RMC. Construction Quality Assurance services are expected to be provided by Advanced GeoServices utilizing personnel experienced in construction and remediation projects.

4.0 QUALITY ASSURANCE/QUALITY CONTROL OBJECTIVES

Site activities performed by the project team at the Site will incorporate, but not be limited to, the QA/QC procedures established herein during the removal activities.

In combination, QA and QC represent a set of procedures designed to produce analytical data of known and acceptable quality. A useful distinction between QA and QC programs can be made as follows: the QC program ensures that all information, data, and decisions resulting from the investigation are technically sound and properly documented, while the QA program assures that the QC program achieve its goals.

Data Quality Objectives (DQOs) are quantitative and qualitative statements specifying the quality of the environmental data required to support the decision making process. Separate DQOs are designed for field sampling and laboratory analysis so that clear distinctions between any problems found in the system can be isolated with respect to cause. Conversely, the DQOs are also designed to provide an indication of the variability of the overall system. The overall QA objective is to keep the total uncertainty within an acceptable range that will not hinder the intended use of the data. To achieve this, specific data requirements such as detection limits, criteria for precision and accuracy, sample representativeness, data comparability and data completeness (PARCC) are specified below.

4.1 PRECISION

Precision measures the reproducibility of data or measurements under specific conditions. Precision is a quantitative measure of the variability of a group of data compared to their average value. Precision is usually stated in terms of relative percent difference (RPD) or relative standard deviation (RSD). Measurement of precision is dependent upon sampling technique and analytical method. Field duplicate and laboratory duplicate samples will be used to measure precision for project samples. Both sampling and analysis will be as consistent as possible. For a pair of measurements, the RPD will be used to evaluate precision. For a series of measurements, RSD will be used to evaluate precision. The total precision of a series of measurements can be related by the additive nature of the variances. Equations for RPD and RSD are presented in Section 13.1 of this SAP.

QC samples, including field and laboratory duplicate samples will be analyzed and used to monitor precision for this project. One field duplicate will be collected for every 20 soil samples. A matrix spike sample and laboratory duplicate sample will be collected at a frequency of one set per 20 samples per matrix. All duplicate results will be evaluated during data validation with respect to the applicable DQO criteria listed in Table 2 and the Region V Standard Operating Procedure for Validation of CLP Inorganic Data (USEPA, 1993).

Precision will be evaluated for all lead analyses performed in this program using the results of field and laboratory duplicate samples.

4.2 ACCURACY

Accuracy is defined as the degree of agreement of a measurement or average of measurements with an accepted reference value. Accuracy measures the bias in a measurement system which may result from sampling or analytical error. Sources of error that may contribute to poor accuracy are:

- laboratory error;
- sampling inconsistency;
- field and/or laboratory contamination;
- sample handling;
- matrix interference; and

- preservation.

Equipment blanks, as well as matrix spike (MS) QC samples, will be used to measure accuracy for project samples. The field component of accuracy will be negligible if the sampling, preservation, and handling techniques described in this SAP are followed. Accuracy in laboratory methods and procedures will be evaluated by use of calibration and calibration verification procedures, and instrument performance solutions, at the frequency specified in the USEPA "Test Methods for Evaluating Solid Waste Physical/Chemical Methods," November 1986, SW-846 3rd edition for lead analyses. Accuracy is calculated using the equation presented in Section 14.2 of this SAP.

Field and laboratory blanks, matrix spike samples and LCSs will be used to measure accuracy for the project samples. Blanks will be used to evaluate whether laboratory or field procedures represent a possible source of contamination. Equipment blanks will be collected one per 20 samples. Matrix spike samples and laboratory duplicates will be analyzed at a frequency of one pair per 20 samples. LCSs will be analyzed at a frequency of one per matrix per 20 samples or per laboratory preparation batch, whichever is more frequent. Accuracy will be evaluated based upon blank and spiked sample results with respect to the applicable DQO criteria listed in Table 2 and the Region V Standard Operating Procedure for Validation of CLP Inorganic Data (USEPA, 1993).

The laboratory method and calibration blanks will be required to meet specific criteria for compliance as listed in SW 846 methodology.

In the data validation, all blank samples will be evaluated. The general procedure for assessing blank samples will be as follows:

- Lead results will be reviewed for all blank samples collected outside of HWMUs.

- Antimony, arsenic, cadmium, lead and selenium results will be reviewed for all blank samples collected inside of HWMUs.

- All blank samples for which lead is reported above the MDL will be identified.

- If contaminants are not detected in any of the blank samples, the data will be reported unqualified for blank contamination.

- If contaminants are found in any of the blank samples, the sample concentration(s) will be reported in the data validation narrative and assessed according to the Region V Standard Operating Procedure for Validation of CLP Inorganic Data (USEPA, 1993).

4.3 DATA REPRESENTATIVENESS

Representativeness expresses the degree to which sample data represent the characteristics of the environment from which they are collected. Samples that are considered representative are properly collected to accurately characterize the contamination at a sample location. Therefore, an adequate number of sampling locations have been chosen, and the samples will be collected in a standardized method. Representativeness will be measured by the collection of field duplicates. Comparison of the analytical results from field duplicates will provide a direct measure of individual sample representativeness.

Comparison of the analytical results from field duplicate samples will provide a direct measure of the representativeness of individual sample results. The RPDs of the field duplicate results will be compared to the project-specific DQOs as given in Table 2.

4.4 DATA COMPLETENESS

Completeness is defined as the percentage of data that is judged to be valid to achieve the objectives of the investigation compared to the total amount of data. Data gaps will be continuously addressed when/if they occur by systematic re-sampling, as needed. Deficiencies in the data may be due to sampling techniques, or poor accuracy, precision, and laboratory error. While deficiencies may affect certain aspects of the data, usable data may still be extracted from applicable samples. The level of completeness, with respect to usable data, will be measured during the data assessment process by comparing the total number of data points to the number of data points determined to be usable. A usability criteria of 90 percent has been set for this project. The equation used for completeness is presented in Section 14.3 of this SAP.

4.5 DATA COMPARABILITY

Comparability expresses the confidence with which one data set can be compared with another data set from a different phase or from a different program. Comparability involves a composite of the above parameters as well as design factors such as sampling and analytical protocols. Data comparability will be ensured by control of sample collection methodology, analytical methodology and data reporting.

4.6 SENSITIVITY

Analytical methods have been selected which can provide the DLs (sensitivity), accuracy and precision criteria defined for this project. Soil samples will be prepared according to USEPA's SW846 (USEPA, 1996) method 3050B, while all field and equipment blanks will be prepared according to SW846 3010A, both hot-acid digestion procedures. All samples will be analyzed using USEPA SW-846 Method 6010B (inductively couples plasma [ICP] spectroscopy).

Specific QLs are highly matrix-dependent and may not always be achievable. See Table 1 for parameters to be analyzed and the corresponding methods and DQO QLs.

4.7 PROCEDURES FOR MONITORING PARCC PARAMETERS

PARCC parameters will be monitored through the submission and analyses of various types of field and laboratory QC samples. These will include appropriate equipment blanks, laboratory method blanks, field duplicates, matrix spikes, and instrument performance solutions. See Table 2 for data quality objectives.

The frequency by which the field and laboratory QC samples will be prepared and submitted is specified in Section 6.5 of this SAP.

5.0 SAMPLING TO BE PERFORMED

This section presents the post excavation screening and confirmatory sampling and analysis procedures to be performed by the QA Representative during CM implementation.

5.1 FIELD XRF SCREENING

During excavation activities within areas specifically designated for post-excavation confirmatory sampling, a portable, hand held XRF device will be utilized to aid in the vertical delineation, and in some cases horizontal delineation, of contaminated material exceeding the Post Remediation Goals (PRG) for the targeted site contaminants depending on the particular remediation area. Screening will completed by performing randomly within the excavations based on a 10-foot by 10-foot grid.

Confirmatory samples will be collected from 0 to 6 inch depth increment in the non-HWMU areas and from the 0-6 inch and 6 t o12 inch depth increment within the HWMUs. Samples will be placed in plastic bags, homogenized and the screened with the XRF. Five separate readings will be obtained on each sample, the results recorded and then averaged. Twenty percent of the XRF samples will be submitted for laboratory analysis and the results utilized to develop a correction factor for the other XRF results. Laboratory analyses of Site metals shall be performed using EPA Method SW-846 6010B.

5.2 CONFIRMATORY SOIL AND SEDIMENT SAMPLING

Confirmation soil samples in both HWMU excavations and non-HWMU excavations will be consistent with the general protocol established for soil samples. Materials will be homogenized by mixing in the plastic baggies for at least one minute prior to XRF testing samples destined for laboratory analysis shall be placed in a laboratory provided sampling container and sent to an off-site lab for analysis (PCB only in non-HWMUs and Sb, As, Cd, Pb and Se in HWMUs). Areas that require additional excavation after the initial confirmation samples have been collected will be identified with the excavation depth. The results of all soil samples, including the XRF sampling results, XRF correlation samples, confirmation samples and duplicates will be entered into a computerized database.

The post-excavation confirmatory sampling program will be implemented by the QA Representative in areas to demonstrate attainment with the appropriate cleanup goals. A typical description of the XRF analysis is provided, but the actual XRF manufacturer instructions should be followed when performing the analysis.

5.3 AIR MONITORING

Air quality on-site sampling and personnel sampling will be conducted by the Contractor and monitored by the QA Representative. This SAP is not intended to cover air monitoring.

6.0 SAMPLE COLLECTION PROCEDURES

6.1 SAMPLE COLLECTION

Prior to sampling, surface debris will be removed from the area using a stainless steel spoon or shovel or disposable scoops. Sampling implements will include stainless steel trowels or disposable plastic scoops, hand augering devices, and plastic Zip-Lock® baggies. Field personnel will don a new, clean pair of disposable gloves prior to sampling at each location. All implements, if not disposable, shall be decontaminated between the collection of each sample using the protocol described in this SAP. During the collection of each sample, the physical characteristics of the soil materials shall be recorded. Samples will be thoroughly mixed in a plastic bag for at least one minute. The plastic bag containing homogenized sample will be labeled and entered on the Chain of Custody. Each soil sample will be of sufficient volume for subsequent analytical testing requirements.

Field personnel will record the soil's physical characteristics, a description of the sample location and depth, the time period for each sample collection, surface conditions surrounding the sample location, and all pertinent meteorological information.

6.2 SOIL SAMPLING DECONTAMINATION

The sampling methods prescribed herein have been developed to minimize the possibility of cross-contamination. Those sampling implements which cannot be decontaminated effectively shall be disposed of between and after sample collection. Decontamination procedures for sampling equipment will be as follows:

- Remove particulate matter and surface films with tap water, Alconox and brush as necessary;
- Deionized water rinse;

- Nitric acid rinse (0.1 N);
- Deionized water rinse;
- Air dry (if possible); and
- Cover with plastic or wrap in aluminum foil if stored overnight.

Equipment blanks will be collected for decontamination QC. A description of the types and frequency of QC samples is included in Section 6.5. Any deviations from these procedures will be documented in the field logbook.

All derived wastes from each sampling event will be returned to the ground in the direct vicinity of the sample collection point.

6.3 FIELD SAMPLING DOCUMENTATION PROCEDURES

Field sampling operations and procedures will be documented by on-site personnel in bound field logbooks. Where appropriate, field operations and procedures will be photographed. Documentation of sampling operations and procedures will include documenting:

- Procedures for preparation of reagents or supplies which become an integral part of the sample (e.g., preservatives and absorbing reagents);
- Procedures for recording the exact location and specific considerations associated with sampling acquisition;
- Specific sample preservation method;
- Calibration of field instruments;
- Submission of field-based blanks, where appropriate;
- Potential interferences present at the Site;
- Field sampling equipment and containers including specific identification numbers of equipment;

- Sampling order;
- Decontamination procedures; and
- Field personnel.

Field logbooks will be waterproof and bound. The logbook will be dedicated to the job. No pages will be removed. Corrections will be made by drawing a single line through the incorrect data and initialing and dating the correction that was made to the side of the error. An initialed diagonal line will be used to indicate the end of an entry or the end of the day's activities.

6.4 SAMPLE CONTAINERS AND PRESERVATION

Table 3 lists the appropriated sample containers, preservation methods, and holding times for sample analysis. Samples will be labeled in the field according to the procedures outlined in Section 7.0 of this Attachment.

6.5 QUALITY CONTROL SAMPLES

Field QC samples will be collected to determine if contamination of samples has occurred in the field and, if possible, to quantify the extent of contamination so that data are not lost. Duplicate samples, equipment blanks and matrix spike (MS) samples will be collected. The duplicate QC samples will be labeled with distinct identification locations and times, and submitted to the laboratory as regular samples. The actual identification of the duplicate QC samples will be recorded in the field logbook.

A summary of the field QA/QC samples to be collected during the sampling program are presented as follows:

- Equipment blanks consisting of laboratory supplied deionized water poured over sampling equipment;
- Duplicate samples for the soil samples sent for laboratory analysis; and,
- Matrix spike.

6.5.1 Duplicate Samples

Duplicate samples are independent samples collected in such a manner that they are equally representative of the sampling point and parameters of interest at a given point in space and time. Field duplicate samples provide precision information of homogeneity, handling, shipping, storage, preparation and analysis.

Soil sample duplicates will be collected and homogenized before being split. Field duplicate samples will be analyzed with the original field samples for the same parameters. One of every twenty samples submitted for laboratory analysis will be duplicated.

6.5.2 Equipment Blanks

The equipment (rinsate) blank is designed to address cross-contamination between sample sources in the field due to deficient field equipment decontamination procedures. This blank also addresses field preservation procedures, environmental Site interference and the integrity of the source water for field cleaning.

An equipment blank will be prepared during soil sampling when a particular piece of sampling equipment was employed for sample collection and subsequently decontaminated in the field for use in additional sampling. The equipment blank will be composed in the field by collecting, in the appropriate container for water, a blank water rinse from the equipment (spoon, auger, corer, etc.) after execution of the last step of the proper field decontamination protocol. Preservatives or additives will be added to the equipment blank where appropriate for the sampling parameters. One equipment blank will be collected per 20 soil samples collected and sent to the off-site lab for lead analysis.

6.5.3 Matrix Spike Samples

An MS will be collected from the same location as the parent sample and will be analyzed for the same parameters as the parent sample. Each sample will be labeled with the sample number as the original sample, designated as an MS sample, and submitted to the laboratory for the appropriate analyses. MS samples determine accuracy by the recovery rates of the compounds added by the laboratory (the MS compounds are defined in the analytical methods). The MS samples also monitor any possible matrix effects specific to samples collected from the Site and the extraction/digestion efficiency. In addition, the analysis of MS samples check precision by comparison of the two spike recoveries. One MS sample will be collected for every 20 investigative and duplicate soil samples collected and sent to the off-site lab for analysis.

7.0 SAMPLE CUSTODY

Sample identification and chain-of-custody shall be maintained for the work through the following chain-of-custody procedures and documentation:

- Sample labels, which prevent misidentification of samples;
- Custody seals to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory;
- Field logbooks to record information about the site investigation and sample collection;
- Chain-of-Custody records to establish the documentation necessary to trace sample possession from the time of collection to laboratory analysis; and,
- Laboratory logbooks and analysis notebooks, which are maintained at the laboratory to record all pertinent information about the sample.

The purpose of these procedures is to ensure that the quality of the sample is maintained during its collection, transportation, storage and analysis. All chain-of-custody requirements shall comply with standard operating procedures indicated in the EPA sample handling protocol. All sample control and chain-of-custody procedures applicable to the subcontracted laboratory will be presented in the laboratory's procedures.

7.1 CHAIN-OF-CUSTODY

A sample is in custody if it is in someone's physical possession or view, locked up or kept in a secure area that is restricted to authorized personnel.

7.1.1 Field Custody Procedures

As few persons as possible should handle samples in the field. The sample collector is personally responsible for the care and custody of samples collected until they are transferred to another person. The QA Representative will determine whether proper custody procedures were followed during field work and decide if additional samples are required.

7.1.2 Sample Labels

Identification labels are to be attached to the field sample containers. The labels shall not obscure any QA/QC lot numbers on the bottles. Sample information will be printed on the label in a legible manner using waterproof ink. The identification on the label must be sufficient to enable cross-reference with the logbook.

7.1.3 Chain-of-Custody

The chain-of-custody record must be completed by the person responsible for sample shipment to the subcontracting laboratory. All constraints on time and analytical procedures should be marked on the record. The custody record should also indicate any special preservation or filtering techniques required by the laboratory.

7.1.4 Transfer of Custody and Shipment

Chain-of-Custody records must be kept with the samples at all times. When transferring the samples, the parties relinquishing and receiving them must sign, date, and note the time on the record. Each shipment of samples to the laboratory must have its own chain-of-custody record with the contents of the shipment, method of shipment, name of courier, and other pertinent information written on the record. The original record accompanies the shipment and the copies are distributed to the Project Manager. Freight bills, Postal Service receipts and bills of lading are retained as permanent documentation.

7.1.5 Custody Seals

Custody seals are adhesive-backed seals with security slots designed to break if the seals are disturbed. Seals are placed on all shipping containers, and seals shall be signed and dated before use.

7.2 SAMPLE DESIGNATION

Samples collected from each location, shall be identified by using a standard label which is attached to the sample container. The following information shall be included on the sample label:

Site name;
Date and time of sample collections;
Designation of the sample (i.e., grab or composite);
Type of sample with brief description of sampling location (depth);
Signature of sampler;
Sample preservative used; and
General types of analyses to be conducted.

7.2.1 Proposed Sample Identification System

The following sample identification system will be utilized to identify the location, type and depth of each soil sample collected. The removal area identification will match the designations shown on the design drawings and the grid location will utilize an alpha-numeric designation developed by the QA Representative in consultation with the Contractor. Addition information will include depth of sample relative to pre-remediation ground surface.

Type of Sample	**Excavation ID/Depth/Date**
XRF Field Screening/Confirmation	XRF-FL4B/1.0-1.5-A5
Lab Analysis Confirmation	FL4B/1.0-1.5/A5
Duplicate	FL4B-D/1.0-1.5/A5

The results of all soil samples, including the XRF sampling results, XRF correlation samples, confirmation samples and duplicates will be entered into a computerized database. The database will be divided into sections labeled with each individual excavation identification and grid number and sub grid number.

7.3 SAMPLE HANDLING, PACKAGING, AND SHIPPING

Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the USDOT in the Code of Federal Regulations, 49 CFR 171 through 177. Samples obtained from the Site are anticipated to be environmental samples which are not expected to contain high levels of hazardous substances. Therefore, the shipment of samples designated as environmental samples are not regulated by DOT.

Samples collected by the QA Representative will be relinquished, directly to the laboratory, to the laboratory courier or shipped to the laboratories using the method described below. Environmental samples shall be packed prior to shipment by air using the following procedures:

Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape.

Allow sufficient outage (ullage) in all bottles to compensate for any pressure and temperature changes (approximately 10 percent of the volume of the container).

Be sure the lids on all bottles are tight (will not leak), and baggies are sealed.

Line coolers with minimum of two large trash bags. Place samples inside of lined coolers. Put ice on top of or between the samples. Pack samples securely to eliminate breakage during shipment. Tie off trash bags to seal.

Place chain-of-custody into a plastic bag, tape the bag to the inner side of the cooler lid and then close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. Custody seals should be affixed to the top and side of the cooler so that the cooler cannot be opened without breaking the seal.

A label containing the name and address of the shipper shall be placed on the outside of the container.

7.4 SAMPLE PRESERVATION AND HOLDING TIMES

When needed, sample containers will be obtained from the subcontracting laboratory and shall be prepared with a predetermined amount of preservative for each specified sample unless otherwise stated in the site specific field plan. A list of preservatives and holding times for each type of analysis are included Table 3 of this Attachment. Additional preservation requirements and holding times for other analytical parameters are listed, in 40 CFR, Part 136, July 1, 1987.

7.5 LABORATORY SAMPLE CUSTODY PROCEDURES

Once the sample arrives at the laboratory, custody of the samples will be maintained by laboratory personnel. Upon receipt of the samples, the sample receipt personnel will remove the chain-of-custody from the sealed cooler and sign and record the date and time on the chain-of-custody. The samples received will be verified to match those listed on the chain-of-custody. The laboratory will document and notify the sample generators QA Manager immediately if any inconsistencies exist in the paperwork associated with the samples. The laboratory at a minimum will document the following stages of analysis: sample receipt, sample extraction/preparation, sample analysis, data reduction, and data reporting.

Samples will be given a unique laboratory identification number and logged into the Laboratory Information Management System (LIMS). The analyst will enter the analytical data into the LIMS upon analysis completion and validation. The LIMS tracks the sample until completion of the report and invoice mailing. The data archived from the LIMS will be transferred to electronic storage format and retained for five years from the completion of sample analysis.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

All instruments and equipment used during sampling and analysis will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations. Operation, calibration and maintenance will be performed by trained personnel on a daily basis. All maintenance and calibration information will be documented and will be available upon request.

9.0 LABORATORY QUALITY ASSURANCE PROGRAM

The quality assurance program for the selected analytical laboratory will be submitted following laboratory selection. The quality assurance program documents are anticipated to include the following:

- Title page;
- Table of contents;
- QA policy statement;
- Laboratory organization and responsibility;
- Sampling procedures and equipment;
- Sample custody;
- Data reduction, validation, and reporting;
- Performance and systems audit;
- Preventive maintenance;
- Corrective action; and
- Resumes.

10.0 DATA REDUCTION VALIDATION AND REPORTING

10.1 DATA REDUCTION

All analytical data will be permanent, complete and retrievable. The analyst will enter the analytical data into the LIMS upon analysis completion and laboratory validation. The laboratory will report sample results on analysis report forms and provide the information referenced in the USEPA Methods for each deliverables package. All laboratory data will undergo the data validation procedures described in the Laboratory QA Manual prior to final reporting. Data will be stored on the laboratory's network until the investigation is complete and data archived from the LIMS will be transferred to magnetic tape which will be retained by the laboratory for an additional five years.

Results will be reported in micrograms per liter (ug/l) for aqueous samples or milligrams per kilogram (mg/kg) for solid samples. Equations to calculate concentrations are found in the SW-846 Method 6010B. All blank results and QC data will be included in the data deliverables package. Blank results will not be subtracted from the sample results. The blank results and QC data will be used in data validation to review sample results qualitatively. Data validation will be performed for soil samples analyzed at the off-site laboratory in general accordance with the guidelines identified in Section 10.2. Outliers and other questionable data will be addressed in the data validation report and specific QA/QC flags will be applied to questionable data. The QA/QC flags will be consistent with the USEPA data validation guidelines.

All analytical data, reports, and any other project related information produced during this project will be stored in the project file at the sample generators office maintained by the Project Manager. Project reports, tables, etc. will be stored in project specific electronic files.

10.2 DATA VALIDATION PROTOCOL

Validation of analytical soil data as received from the off-site laboratory will be performed by an AGC QA Scientist. Validation will be performed in general accordance with the following data validation guidance documents, where applicable:

- National Functional Guidelines for Inorganic Data Review, Multi-Media, Multi-Concentration. USEPA, February 1994.

- Region V Standard Operating Procedures for Validation of CLP Inorganic Data, USEPA, September 1993.

Specifically the information examined will consist of sample results, analytical holding times, sample preservation, chains-of-custody, initial and continuing calibrations, field and laboratory blank analysis results, instrument performance check sample results, MS/MSD recoveries and RPD and field duplicate recoveries. If the criteria listed in the analytical method are not met for any parameter the associated samples will be flagged as described in the referenced validation guidelines. During data validation, data is also reviewed for transcription, calculation, and reporting errors. Calculations for obtaining concentration data for all parameters may be found in the referenced methods.

The purpose of data validation is to verify and retrace the path of the sample from the time of receipt for analysis to the time the final data package report is generated. Upon completion of data validation, the existing results will be reported in tabular form with data validation flags applied as appropriate to determine the usefulness of the data. The data validation flags will be consistent with the USEPA data validation guidelines. A data validation report will be written to assist the Project Manager in making decisions based on the analytical results.

10.3 DATA VALIDATION REPORTS

Data validation reports, along with copies of all support documentation, validated data summary tables, and analytical data packages, will be submitted periodically as data are validated.

10.4 DATA REPORTING

All data deliverables from each laboratory must be paginated in ascending order. The laboratory must keep a copy of the paginated package in order to be able to respond efficiently to data validation inquiries. Any errors in reporting identified during the data validation process must be corrected by the laboratory as requested. All data validation inquiries to the laboratory must be addressed by a written response from the laboratory in question. The data deliverable required for this project will include a case narrative, the sample results (Form 1s), blank data, MS/MSD percent recoveries and relative percent differences, laboratory control sample percent recoveries, and any other quality control data.

11.0 INTERNAL LABORATORY QUALITY CONTROL CHECK SAMPLES AND CALCULATIONS

All QC procedures employed by the laboratory will be, at a minimum, equivalent to those required in the specified analytical methods. Laboratory QC checks are accomplished through the analyses of laboratory blanks, calibration verifications, laboratory control standards and performance evaluation samples. When internal QC results fall outside method acceptance criteria, the data will be reported, and the analysis repeated, flagged or accepted according to the specified analytical methods. The following sections describe internal laboratory QC check samples.

11.1 LABORATORY BLANKS

Method blanks are generated within the laboratory during the processing of the actual samples. These blanks will be prepared using the same reagents and procedures and at the same time as the project samples are being analyzed. If contamination is found in the method blank, it indicates that similar contamination found in associated samples may have been introduced in the laboratory and may not have been actually present in the samples themselves. Guidelines for accepting or rejecting data based on the level of contamination found in the method blank are presented in the specified analytical method.

A minimum of one method blank per 20 samples will be analyzed or, in the event that an analytical round consists of less than 20 samples, one method blank sample will be analyzed per round.

11.2 MATRIX SPIKE/MATRIX SPIKE DUPLICATES

MS analyses are performed in association with metal analyses. MS are prepared by placing a known quantity of selected target analytes into a second aliquot of an actual field sample. The spiking occurs prior to sample preparation and analysis. The MS is then processed in a manner identical to the field sample. Recovery of each of the spiked compounds reflects the ability of the laboratory and method to accurately determine the quantity of that analyte in that particular sample.

11.3 LABORATORY CONTROL SAMPLE

The Laboratory Control Sample (LCS) is prepared by the laboratory by adding analytes of known concentrations to solution (DI water for metals analysis) for analyses. The LCS is prepared, analyzed and reported once per sample delivery group (SDG). The LCS must be prepared and analyzed concurrently with the samples in the SDG using the same instrumentation as the samples in the SDG. The LCS is designed to access (on a SDG-by-SDG basis) the capability of the laboratory to perform the analytical methods. If the analytes present in the LCS are not recovered within the criteria defined in the specified analytical methods, the samples will be reanalyzed or data will be flagged.

12.0 PERFORMANCE AND SYSTEM AUDITS

12.1 LABORATORY AUDITS

The purpose of a quality assurance audit is to provide an objective, independent assessment of a measurement effort. The quality assurance audit ensures that the laboratory's data generating, data gathering, and measurement activities produce reliable and valid results. There are two forms of quality assurance audits: performance evaluation audits and system audits.

12.1.1 Performance Evaluation Audits

The purpose of performance evaluation audits is to quantitatively measure the quality of the data. These audits provide a direct evaluation of the various measurement systems' capabilities to generate quality data.

The laboratory regularly participates in performance evaluation audits as part of their laboratory certification efforts. Performance audits are conducted by introducing control samples in addition to those routinely used.

The results of the performance audits are summarized and maintained by the Laboratory QA Supervisor and distributed to the section supervisors who must investigate and respond to any out of control results.

12.1.2 Technical System Audits

A technical systems audit is an on-site, qualitative review of the various aspects of a total sampling and/or analytical system. The purpose of the technical systems audit is to assess the overall effectiveness, through an objective evaluation, of a set of interactive systems with respect to strength, deficiencies, and potential areas of concern. Typically, the audit consists of observations and documentation of all aspects of sample analyses. External and internal audits are conducted of the laboratory throughout each year.

13.0 PREVENTATIVE MAINTENANCE**Error! Bookmark not defined.**

13.1 FIELD EQUIPMENT

Field measurement equipment and the XRF unit will be maintained in accordance with manufacturer's instructions. All field equipment will be checked by qualified technicians prior to use in the field. The instrument operator will be responsible for ensuring that the equipment is operating properly prior to use in the field. Any problems encountered while operating the instrument will be documented in the field logbook. If problem equipment is detected or should require service, the equipment will be returned and a qualified technician will perform the maintenance required. Use of the instrument will not be resumed until the problem is resolved. Routine maintenance of field instruments will be documented in the field logbooks.

13.2 LABORATORY EQUIPMENT

Preventative maintenance and periodic maintenance is performed as recommended by the manufacturers of the equipment in use in the laboratory. Spare parts are kept in inventory to allow for minor maintenance. Service contracts are maintained for most major instruments, balances and critical equipment. If an instrument fails, the problem will be diagnosed as quickly as possible, and either replacement parts will be ordered or a service call will be placed.

Laboratory logbooks are kept by the laboratory to track the performance maintenance history of all major pieces of equipment. The instrument maintenance logbooks are available for review upon request. Specific details of preventative maintenance programs for the laboratory will be provided in the Laboratory QA Manual.

14.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

14.1 PRECISION

The precision of laboratory test results will be expressed as RPD or RSD. RPD is derived from the absolute difference between duplicate analyses divided by the mean value of the duplicates. The percent RSD is obtained by dividing the standard deviation by X. Equations for RPD and RSD are presented below:

$$RPD = \frac{|D1 - D2|}{(D1 + D2)/2} \times 100$$

Where:

D1 and D2 = the two replicate values

$$RSD = \frac{S}{X}\text{; and } S = [n\,(x_i - x)^2/n-1]^{1/2}$$

$$i\text{-}1$$

Where:

S	=	standard deviation
x_i	=	each observed value
x	=	the arithmetic mean of all observed values
n	=	total number of values

14.2 ACCURACY

Accuracy will be calculated on the average percent recovery of spiked samples. Reference materials are essential to the evaluation of accuracy. Stock solutions for accuracy spikes and QC standards (if possible) shall be traceable to a source independent from the calibration standards. Accuracy is calculated using the following equation:

$$\%R = \frac{SSR - SR}{SA} = 100$$

Where:

%R	=	% recovery
SSR	=	spike sample result
SR	=	sample result
SA	=	amount of spike

14.3 DATA COMPLETENESS

Completeness is evaluated by dividing the total number of verifiable data points by the maximum number of data points possible and expressing the ratio as a percent. A usability criteria of 90 percent has been set for this project. The equation used for completeness is presented below:

$$C(\%) = \frac{D}{P \times n} \times 100$$

Where:

D	=	number of confident quantifications
P	=	number of analytical parameters per sample requested for analysis
n	=	number of samples requested for analysis

15.0 CORRECTIVE ACTION

When field sampling activities or laboratory QC results show the need for corrective action, immediate action will take place and will be properly documented. In the event that a problem arises, corrective action will be implemented. Any error or problem will be corrected by an appropriate action which may include:

- Replacing or repairing a faulty measurement system;
- Discarding erroneous data;
- Collecting new data; and
- Accepting the data and acknowledging a level of uncertainty.

15.1 FIELD SAMPLING CORRECTIVE ACTION

The on-site Principle Investigator will be responsible for all field QA. Any out of protocol occurrence discovered during field sampling will be documented in the field logbook and immediate corrective action will be taken. For problems or situations which cannot be solved through immediate corrective action, the Principle Investigator will immediately notify the AGC Project Manager. The AGC Project Manager and Principle Investigator will investigate the situation and determine who will be responsible for implementing the corrective action. Corrective action will be implemented upon approval by the AGC Project Manager. The Project Manager will verify that the corrective action has been taken, appears effective, and at a later date, verify that the problem has been resolved. The successfully implemented corrective action will be documented in the field logbook by the on-site Principle Investigator. Any deviations from the QA protocol in the SAP must be justified, approved by the AGC Project Manager (and IDEM and the USEPA, if necessary), and properly documented.

15.2 LABORATORY SITUATION CORRECTIVE ACTION

Corrective action will be implemented to correct discrepancies found which affect the validity or quality of analytical data, and to identify any analytical data that may have been affected. Limits of data acceptability for each parameter and sample matrix are addressed in the instrument manuals, USEPA Methods and/or Laboratory QA Manual. Whenever possible, immediate corrective action procedures will be employed. All analyst corrective actions are to be followed according to the instrument manuals, USEPA Methods, or Laboratory QA Manual. Any corrective action performed by the analyst will be noted in laboratory logbooks.

Laboratory personnel noting a situation or problem which cannot be solved through immediate corrective action will notify the Laboratory QA Supervisor. The QA Supervisor will investigate the extent of the problem and its effect on the analytical data generated while the deficiency existed. All data suspected of being affected will be scrutinized to determine the impact of the problem on the quality of the data. If it is determined that the deficiency had no impact on the data, this finding will be documented. If the quality of the analytical data were affected, the Laboratory Program Manager and the sample generator's Project Manager will be notified immediately so that courses of action may be identified to determine how to rectify the situation.

The laboratory must take corrective action if any of the QC data generated during the laboratory analyses are outside of the method criteria. Corrective action for out-of-control calibrations is to recalibrate the instrument and re-analyze the samples. A sequence is specified in the USEPA specified methods when problems in analyses are encountered. The laboratory will follow these procedures exactly and document the problems encountered and the corrective action in a case narrative enclosed with each data deliverables package.

The Laboratory QA Supervisor will be responsible for informing the Laboratory Program Manager and sample generator's Project Manager of the effects on the data, the data affected and the corrective action taken. It is also the Laboratory QA Supervisor's responsibility to verify that the corrective action was performed, appears effective, and at a later date, the problem was resolved.

15.3 DATA VALIDATION QA CORRECTIVE ACTION

Upon completion, sample data packages will be sent from the laboratory to the sample generator's QA Scientist for data validation. If all project samples are not present in the data packages or any deficiencies affecting the sample results are noted, the QA Scientist will contact the Laboratory QA Supervisor. The Laboratory QA Supervisor will respond in writing to any inquiries and provide any changes to the data packages to the QA Scientist. Any errors, problems, questionable data values, or data values outside of established control limits will be corrected by the appropriate action which may include disregarding erroneous data, collecting new data, and accepting the data and acknowledging a level of uncertainty. The data validation report will provide a description of the usability of the data.

TABLE 1
SAMPLING PARAMETERS AND REPORTING LIMITS
RMC Beechgrove, Indiana

LOCATION	MATRIX	METHOD	PARAMETER	RL	DQO	UNITS
HWMU	Soil/Sediment	SW-846 6020[1]	Antimony	1	37	mg/kg
		SW-846 6010B[1]	Arsenic	10	20	mg/kg
			Cadmium	1	77	mg/kg
			Lead	5	970	mg/kg
			Selenium	10	53	mg/kg
outside HWMU, but still onsite		SW-846 6010B[1]	Lead	5	920	mg/kg
Offsite		SW-846 6010B[1]	Lead	5	400	mg/kg
Equipment Blanks	Aqueous	SW-846 6020[1]	Total Antimony	10	N/A	µg/L
		SW-846 6010B[1]	Total Arsenic	100	N/A	µg/L
			Total Cadmium	10	N/A	µg/L
			Total Lead	50	N/A	µg/L
			Total Selenium	100	N/A	µg/L

Notes:
Antimony will be analyzed by SW-846 6020A
µg/L: micrograms per liter RL: Reporting Limit
mg/L: milligrams per liter DQO: Data Quality Objective
mg/kg: milligrams per kilogram N/A: not applicable

[1]USEPA "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", Feb. 2007, SW-846, 6th Revision.

TABLE 2
DATA QUALITY OBJECTIVES
RMC Beechgrove, Indiana

DQO PARAMETER	**LABORATORY PARAMETERS (aqueous)**	**LABORATORY PARAMETERS (soil/sediment)**
PRECISION		
Matrix Spike	<20% RPD for results > 5*RL <±RL for results < 5*RL	<35% RPD for results > 5*RL <±2*RL for results < 5*RL
Field Duplicate	<30% RPD for results > 5*RL <±RL for results < 5*RL	<50% RPD for results > 5*RL <±2*RL for results < 5*RL
ACCURACY		
Laboratory Blank	<RL	<RL
Equipment Blank	<RL	<RL
Matrix Spike	80-120 %R unless sample concentration exceeds the spike added by a factor of 4 or more.	75-125 %R unless sample concentration exceeds the spike added by a factor of 4 or more.
Laboratory Control Sample	80-120 %R	80-120 %R
COMPLETENESS	90%	90%
COMPARABILITY	Based on precision, accuracy and media comparison	Based on precision, accuracy and media comparison

RPD: Relative percent difference.
RL: Reporting limit
%R: Percent recovery.

TABLE 3
SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
RMC Beechgrove, Indiana

LOCATION	MATRIX	METHOD	PARAMETER	CONTAINER	PRESERVATIVE	HOLDING TIME
HWMU Areas	Soil/Sediment	SW-846 6010B[1]	Antimony, Arsenic, Cadmium, Lead, Selenium	zip lock baggies	none	6 months
Non-HWMU Onsite Areas	Soil/Sediment	SW-846 6010B[1]	Lead	zip lock baggies	none	6 months
Offsite Areas	Soil/Sediment	SW-846 6010B[1]	Lead	zip lock baggies	none	6 months
Equipment Blanks	Aqueous	SW-846 6010B[1]	Antimony, Arsenic, Cadmium, Lead, Selenium	1 L plastic	HNO_3 pH<2; cool 4° C	6 months

[1]USEPA "Test Methods for Evaluating Solid Waste: Physical/Chemical Methods", Feb. 2007, SW-846, 6th Revision.

ATTACHMENT E

Operation and Maintenance Plan

OPERATION AND MAINTENANCE PLAN
POST CORRECTIVE MEASURES IMPLEMENTATION
FORMER REFINED METALS CORPORATION FACILITY
BEECH GROVE, INDIANA

Prepared for:

Refined Metals Corporation
Beech Grove, Indiana

Prepared by:

ADVANCED GEOSERVICES CORP.
West Chester, Pennsylvania

Project No. 2003-1046-18
April 12, 2010

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1.0 INTRODUCTION

1.1 PURPOSE

This Operation and Maintenance Plan (O&M Plan) describes the required inspection and maintenance activities for the post-closure period following the completion of corrective measures and Hazardous Waste Management Unit (HWMU) closure at the former Refined Metals Corporation facility situated at 3700 South Arlington Avenue in Beech Grove, Indiana (the Site). This Plan was written in accordance with requirements of Exhibit D "Scope of Work for a Corrective Measures Implementation" Task XIII(B) Operation and Maintenance Plan of the Consent Decree.

This O&M Plan has been prepared in anticipation that corrective measures and closure activities will be completed as described in the Pre-Final Corrective Measures Design, as prepared by Advanced GeoServices Corp April 12, 2010.

1.2 SCOPE

The post-closure care operation and maintenance will include activities related to the following Corrective Measures components:

- Containment Cell;
- Groundwater Monitored Natural Attenuation (MNA);
- Storm Water Management; and,
- Institutional Controls and Site Security.

Post-closure care will be enforced for 30 years following closure per 40 CFR 264.117 unless in the opinion of USEPA or IDEM the monitoring period may be shortened or must be extended. Post-closure care will be evaluated periodically to determine if modified post-closure activities are sufficient to protect human health and the environment.

1.3 CONTACT

In accordance with state and federal regulations, the name, address, and phone number of the person or office to contact about the facility during the post-closure period is included. At this time, the information is as follows:

Refined Metals Corporation
c/o Exide Technologies, Inc.
3000 Montrose Avenue
Reading, PA 19605

Attention: Mr. Matthew Love
Director of Environmental Affairs
(610) 921-4054

1.4 ORGANIZATION

Pursuant to Exhibit D of the Consent Decree, the remainder of this document includes the following Section:

- Section 2.0 Description of Normal Operation and Maintenance
- Section 3.0 Description of Potential O&M Problems and Corrective Steps
- Section 4.0 Description of Routine Monitoring and Laboratory Testing.
- Section 5.0 Safety Plan

- Section 6.0 Records and Reporting

2.0 NORMAL OPERATION AND MAINTENANCE

2.1 GENERAL

The Corrective Measures design was prepared with the intent of providing a post-closure condition that functions and remains stable with minimal operation and maintenance requirements. Normal O&M requirements for the site are expected to be limited to periodic inspections and routine maintenance. The observations to be made during the inspections and routine maintenance requirements are as follows.

2.2 VEGETATIVE COVER

The vegetative cover will be inspected quarterly during the first year following completion of CM construction, semi-annually during the second and third years following completion of CM construction and annually thereafter. The inspector will ensure that the vegetative ground cover in the containment cell cap and those areas on-site stabilized with turf are fully established and remain stable. Until establishment of a stabilized vegetative surface the inspector will determine whether additional seeding, mulching, or watering is necessary. The turf and lawn areas of the RMC owned property will be mowed at least annually or as necessary for routine maintenance. The vegetative cover on the cell and in the storm water management basins will be mowed to a typical height of 6 inches to protect the growth of low lying legume grasses. The sod within the right-of-way for South Arlington Avenue and turf along the southern fence line of the Citizens Gas property will be inspected for acceptability of establishment during the first year in conjunction with the quarterly on-site inspections. The property owners will be responsible for routine maintenance mowing; however, RMC will be responsible for addressing property owner concerns regarding adequacy and acceptability of the restoration during the first year following construction. Condition of the vegetative cover observed during the inspections will be recorded in the appropriate sections of the inspection Form.

2.3 CONTAINEMNT CELL CAP STABILITY

The containment cell cap and berm will be visually inspected to ensure the integrity and effectiveness of the final cover and note any repairs necessary to correct the effects of settling, subsidence, sliding, or erosion. The cap will be inspected quarterly during the first year following completion of CM construction, semi-annually during the second and third years following completion of CM construction, and annually thereafter. The visual evaluation of slopes associated with the final grading plan of the Containment Cell will include, but is not limited to, the following observations:

- Areas of ponding or subsidence
- an improperly anchored liner,
- burrowing animals,
- development of woody vegetative growth that may damage geomembrane,
- soil sliding or sloughing, and
- soil tensile cracking.

Condition of the containment cell and berm observed during the inspections will be recorded in the appropriate sections of the inspection Form.

2.4 INSTITUTIONAL CONTROL AND SITE SECURITY

A visual evaluation of the perimeter chain-link fencing will be conducted quarterly during the first year following completion of CM construction, semi-annually during the second and third years following completion of CM construction, and annually thereafter. The inspections will include, but not be limited to, the following:

- Observing the fence for vandalism or damage

- Confirming that gates and locks are operational.
- Evaluating the site for improper use or development, and,
- Presence of required signage.

Condition of the security fence and site observed during the inspections will be recorded in the appropriate sections of the inspection Form.

2.5 STORM WATER SYSTEM

The storm water management systems will be evaluated during inspections and includes verifying that all storm water controls (i.e., channels, storm water basins and outlets) are working properly and are without defect. Inspections will be conducted quarterly during the first year following completion of CM construction, semi-annually during the second and third years following completion of CM construction, and annually thereafter. Channels, storm water basins, and basin outlet structures will be inspected for blockage or clogging from sediment or debris. The inspector will also verify that run-on and run-off are not eroding or damaging the final cover. Condition of the storm water system observed during the inspections will be recorded in the appropriate sections of the inspection Form.

2.6 GROUNDWATER MONITORING

Groundwater monitoring is proposed as a means of evaluating post Corrective Measure groundwater quality in the vicinity of the containment cell (Containment Cell Groundwater Monitoring) and to determine the trends in groundwater quality following completion of the CM implementation (MNA Groundwater Monitoring). Groundwater sampling for both types of groundwater monitoring will be performed quarterly during the first year following completion of the CM implementation, semi-annually during years 2 and 3 and annually thereafter until RMC can demonstrate to the satisfaction of USEPA that the containment cell is not detrimentally impacting groundwater and that previous groundwater impacts have stabilized. The monitoring and laboratory testing requirements for groundwater are described in Section 4.0 if the O&M Plan.

3.0 POTENTIAL O&M PROBLEMS AND CORRECTIVE STEPS

3.1 VEGETATIVE COVER

Operating problems likely to be documented during the routine inspections may include insufficient germination of turf seeding, dead or dying sod, excessive erosion, insufficient maintenance and/or damage caused by mowing equipment.

3.1.1 Insufficient Germination/Sod Establishment - Insufficient grass seed germination or sod establishment will be observed in the form of bare spots in the soil, spotty germination, stunted grass growth or other conditions lacking lushness or continuity. Causes for such conditions are numerous and the inspector will require the Contractor that performed the seeding and maintenance diagnose and mitigate the problem. Such measures related to seeding may include any combination of over-seeding, additional watering, or supplemental fertilizing. Measures related to sod may include replacing the sod, increasing the frequency of watering (for under-watered conditions) or reducing the amount of watering (for over-watered conditions).

3.1.2 Erosion – Erosion is most likely to occur on those areas that are more steeply sloped and/or in those areas where concentrated surface water flows and is more prominent in areas of poor vegetative growth. Erosion is most likely to occur in the first year following CM implementation, during which time the Contractor will be required to facilitate repairs. After the first year, erosion will usually be the result of an unusually significant precipitation event or surficial disturbance (such as tire rutting). In areas of vegetation, repair is most effectively performed by eliminating or managing the cause of the erosion; backfilling the erosion rills with soil and topsoil, as appropriate; reseeding and installation of erosion control blanket. In areas protected by crushed stoned or crushed concrete, the repair will also require eliminating or managing the cause of the erosion to the extent possible and restoring the crushed stone or concrete. The precise methods will be determined by the inspector based on the actual conditions observed. If erosion has resulted in exposure of contents of the containment cell or damage to the cap geomembrane USEPA shall be notified.

3.1.3 Insufficient Maintenance or Maintenance Related Damage – Insufficient maintenance of the vegetative cover or maintenance related damage will likely be limited to lack of mowing on the containment cell cap, rutting caused by lawn mowing or other vehicular traffic when surface soils are too wet, or damage to established turf by cutting the grass too short. Indications will be obvious at the time of inspection in the form of excessive vegetative growth (especially woody growth), tire ruts, or damage or disturbance of previously established growth. Corrective measures could include arranging to have the unmaintained areas mowed, backfilling and reseeding the areas of ruts, or modifying the mowing techniques and repair areas of excessive damage.

3.2 CONTAINMENT CELL CAP STABILITY

Instability of the containment cell cap would most likely occur in the form of soil creep or interface sliding down the steepest portions of the slope; settlement or subsidence in the flat areas of the cap; and excavations, tunnels or burrows by animal or manmade.

3.2.1 Soil Creep or Interface Sliding – Soil creep occurs when the cover soil is moving down the slope because of insufficient internal shear strength and usually occurs shortly following cap construction or following a period when the cover soil has become saturated. Interface sliding also typically occurs shortly after or during construction and is the result of inadequate interface friction between cap geosynthetic components. If such movement occurs it is most commonly observed in the form of gaping cracks in the cover soil at the top of the slope perpendicular to the slope, and/or as mounding at or near the toe of the slope. Such movement will require immediate notification to the USEPA and evaluation by a geotechnical engineer to determine the significance of the movement and whether or not repairs are necessary. If repairs are necessary the geotechnical engineer will provide written recommendations for repairs for review and approval by the USEPA.

3.2.2 Settlement or Subsidence – Settlement and subsidence occur when the materials placed in the containment cell and/or the cover soil materials were insufficiently compacted. Settlement and subsidence usually occur locally and are observed as surface irregularities or areas of poor drainage on the flatter portions of the cap. The extent of repairs is a function of the amount of settlement or subsidence. For small areas with limited amounts of settlement or subsidence the corrective measure will be the additional of topsoil to eliminate the low spots and areas of standing water. For large areas of significant settlement, an Engineer shall evaluate the problem area and develop written recommendations.

3.2.3 Excavations, Tunnels and Burrows – Excavations through the cover soil have the potential to damage the geocomposite drainage layer and geomembrane. During inspections, the inspector will look for disturbance of the cap. For tunnels or burrows caused by wildlife the resulting penetration shall be sealed and the area revegetated. For manmade penetrations the inspector shall attempt identify and contact the party responsible for the excavation to determine the reason for the disturbance and the depth. If damage of the geosynthetic components is suspected the liner shall be exposed, evaluated and repaired as appropriate.

3.3 INSTITUTIONAL CONTROLS AND SITE SECURITY

During inspections, the site security fence shall be evaluated for damage and the site property will be evaluated for excavations or other activities that being performed without consideration of institutional controls imposed on the property. If damage to the security fence is observed the resulting damage shall be repaired. If excavations or other activities are indentified they shall be brought to the immediate attention of RMC and as appropriate RMC will notify USEPA.

3.4 STORM WATER SYSTEM

Potential problems with the storm water management system will be erosion of the drainage ditches, clogging of the drainage ditches or storm water management basin outlet structures by accumulated sediment, debris or vegetative growth. If observed, the Inspector will notify RMC who will make arrangements for appropriate maintenance and restoration of operational conditions.

4.0 ROUTINE SAMPLING AND LABORATORY TESTING

4.1 GENERAL

Routine sampling and laboratory testing is limited to groundwater sampling required as part of the Containment Cell Groundwater Monitoring and MNA Groundwater Monitoring.

4.2 CONTAINMENT CELL GROUNDWATER MONITORING

As part of O&M, RMC proposes to collect and analyze samples from four (4) shallow groundwater monitoring wells proposed to be installed around the containment cell (CC-1 through CC-4). Synoptic water levels will be collected during each sampling event from all Site groundwater monitoring wells (CC-1, CC-2 CC-3 CC-4, MW-1, MW-3, MW-4, MW-5, MW-6D, MW-6SR, MW-8, MW-9, MW-11 and MW-12) at the Site.

Proposed wells CC-1 through CC-4 will be sampled once per quarter for at least two consecutive quarters before the start of CM implementation and once per quarter for one year following the completion of CM implementation. Groundwater sampling will be performed semi-annually in the second and third years following completion of CM implementation and annually thereafter. Samples will be submitted to Tri-Matrix Laboratories (Grand Rapids, Michigan) and analyzed. Groundwater samples performed for containment cell monitoring will be analyzed for Indicator Parameters and Site Specific Parameters as follows:

Groundwater Indicator Parameters

- Field and Laboratory pH
- Field Specific Conductance
- Total Organic Carbon (TOC)

- Field Turbidity

Site Specific Parameters

- Antimony (filtered and unfiltered)
- Arsenic (filtered and unfiltered
- Lead (filtered and unfiltered)

Sampling equipment and method procedures shall be consistent with the Groundwater Monitoring Plan currently followed for quarterly groundwater sampling performed under IDEM for the lagoon. Analysis for site specific parameters will include filtered and unfiltered samples to allow clarification and understanding of contribution by suspended solids (un-filtered results minus filtered results) versus actual water quality (filtered results).

Analytical data packages will be reviewed and validated by a qualified data validator. An initial report will be provided to USEPA with the subsequent inspection report. In addition, on or before March 1 of every year, the results of the sampling for the previous year will be submitted to the in an Annual Groundwater Report. The results will include a groundwater contour map for depth to water measurements taken at the time of each sampling event, a table of results specific to each sampling event, and a summary table on a well by well basis.

4.3 MNA GROUNDWATER MONITORING

Historic groundwater sampling has identified elevated concentrations of lead and arsenic in shallow perched groundwater in the northwest portions of the former manufacturing area. Under this plan, RMC proposes to collect and analyze samples from five (5) shallow groundwater monitoring wells. Sampling will be performed once per quarter for at least two consecutive quarters before the start of CM implementation and once per calendar quarter for one year following the completion of CM implementation. Groundwater sampling will be performed semi-annually in the second and third years following completion of CM implementation and annually thereafter.

The groundwater monitoring wells to be included as part of the MNA Groundwater Monitoring will consist of the following:

- MW-1
- CC-1 (Intended as surrogate well for MW-2)
- CC-4 (Intended as surrogate well for MW-7 and MW-10)
- MW- 3; and
- MW-8.

MNA Monitoring Wells will be sampled following completion of Corrective Measures during year 1, semi-annual during years 2 and 3, and annually during years 4 and 5, with the frequency after 5 years dependent upon the results of the sampling) for total and dissolved concentrations of arsenic and lead. In addition, one sampling event per year during years 1 through 5 will evaluate total concentrations of major ions (Ca, Mg, Na, K, HCO3/CO3, Cl, SO4, and NO3); and complexing ions (Fe2 and Fe3, Mn and Al), for possible future use in geochemical modeling, if required based on stability monitoring. Field parameters readings, including temperature, pH, Eh, DO, alkalinity, specific conductance and turbidity will be taken during every sampling round

Results (arsenic and/or lead as listed above) from the sampling performed in the MNA Groundwater Monitoring Wells will be evaluated using stability monitoring. The evaluation will utilize the Mann-Kendall test to evaluate trends in the data on a well by well basis to determine if the plume is expanding (concentrations increasing), shrinking (concentrations decreasing), or stable.

Sampling equipment and method procedures shall be consistent with the Groundwater Monitoring Plan currently followed for quarterly groundwater sampling performed under IDEM for the lagoon. Analysis for site specific parameters will include filtered and unfiltered samples to allow clarification and understanding of contribution by suspended solids (un-filtered results minus filtered results) versus actual water quality (filtered results).

5.0 SAFETY PLAN

The Contractor responsible for conducting inspections and performing groundwater sampling shall maintain and observe a Health and Safety Plan applicable to the proposed O&M activities. Personnel performing the site inspections and sampling shall have current OSHA required Health and Safety Training and medical monitoring.

6.0 RECORDS AND REPORTING

A post-closure inspection form and site map will be completed during all inspections. A written inspection report on the condition of the Site will be submitted to USEPA and IDEM for each inspection.

Analytical data packages will be reviewed and validated by a qualified data validator. An initial report will be provided to USEPA with the subsequent inspection report. In addition, on or before March 1 of every year, the results of the sampling for the previous year will be submitted to the in an Annual Groundwater Report. The results will include a groundwater contour map for depth to water measurements taken at the time of each sampling event, a table of results specific to each sampling event, and a summary table on a well by well basis.

TABLE 1

POST-CORRECTIVE MEASURES INSPECTION FORM
FORMER REFINED METALS CORPORATION FACILITY
BEECH GROVE, INDIANA

INSPECTOR'S NAME:________________ INSPECTION DATE:________________

INSPECTION ITEM	INSPECTED Y OR N	INSPECTION OBSERVATIONS	MAINTENANCE WORK PERFORMED
1. VEGETATIVE COVER ☐ Adequate Grass Growth			
☐ Additional Seeding or Mulching			
☐ Watering Required			
☐ Grass Length/Mowing			
☐ Other			
2. FINAL COVER CAP INTEGRITY ☐ Settling, Subsidence, Erosion			
☐ Soil Cracking			
☐ Water Ponding			
☐ Leachate Seeps/Odor			
☐ Animal Burrows			
☐ Other			
3. SLOPE STABILITY ☐ Failure/Deterioration			
☐ Erosion/Vegetation			
4. FENCING ☐ Deterioration/Damage			
☐ Signs			
☐ Burrowing Under Fence			
5. STORM WATER SYSTEMS ☐ Blockage/Clogging			
☐ Deterioration/Damage			

ATTACHMENT F

Construction Cost Estimate

PRE-FINAL COST ESTIMATE

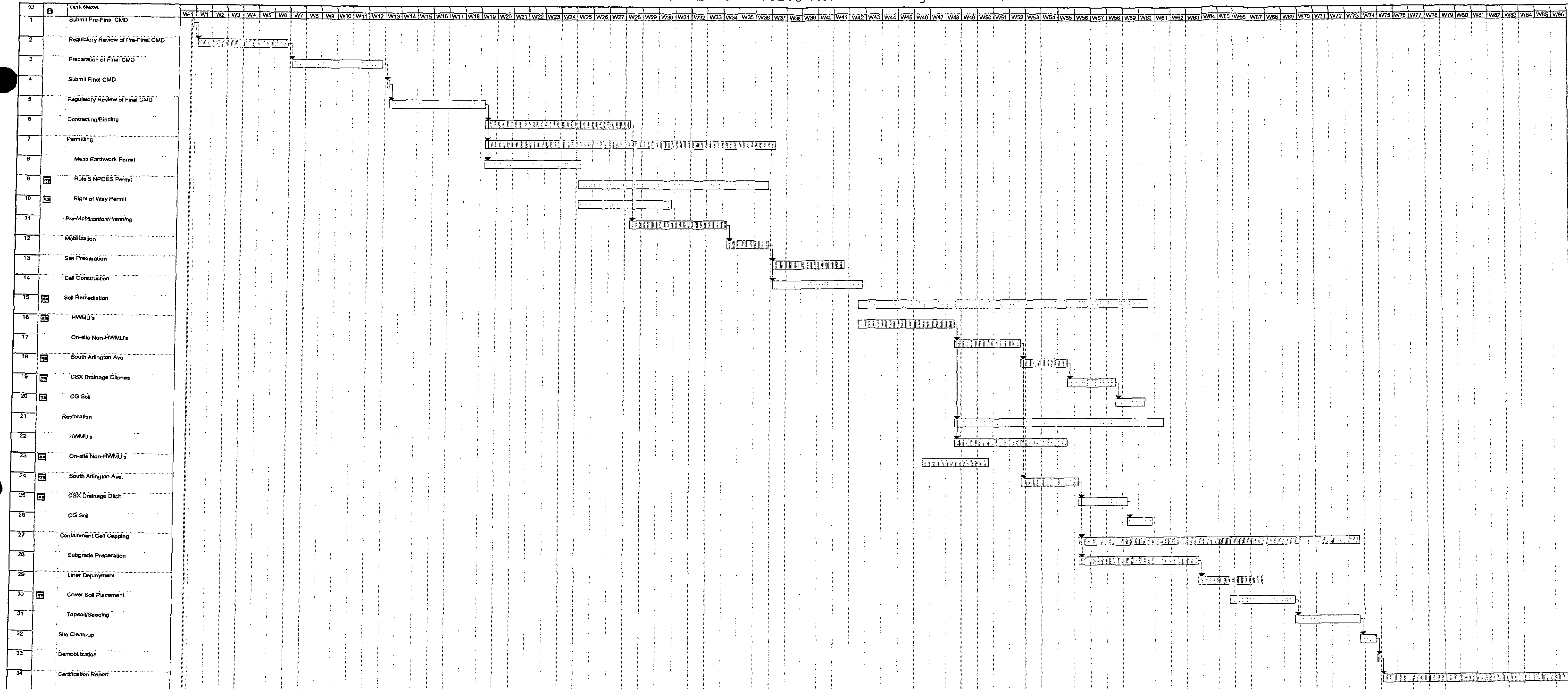
Pay Item	Pay Unit	Cost	Number/Size of Items	Extended Cost
Site Preparation	Lump Sum	$50,000		$50,000
Clearing and Grubbing	Lump Sum	$20,000		$20,000
Unreinforced Silt Fence	Lineal Foot	$4.10/ft.	2,000 ft.	$8,200
Construction Entrance	Each	$4,000 each	2	$8,000
Decontamination Pad	Each	$6,000 each	2	$12,000
Haul Road	Lineal Foot	$20/ft.	350 ft.	$7,000
Pumphouse Demolition	Each	$1,500 each	4	$6,000
Loading Dock Demolition	Lump Sum	$5,000		$5,000
Concrete and Asphalt Pavement Demolition	Lump Sum	$12,000		$12,000
Water Treatment	Lump Sum	$40,000		$40,000
Removal/Handling/Placement Soils and Sediment	Cubic Yard	$7/cy.	12,848 cy.	$89,936
Structural Soil Fill	Cubic Yard	$9.20/cy.	10,000 cy.	$92,000
General Soil Fill	Cubic Yard	$7/cy.	500 cy.	$3,500
Granular Fill	Square Yard	$6/sy.	24,457 sy.	$146,742
Cap Soil Fill	Square Yard	$12/sy.	7,000 sy.	$84,000
60 mil. Textured HDPE	Square Yard	$11.50/sy.	7,000 sy.	$80,500
Composite Drainage Layer	Square Yard	$4.85/sy.	7,000 sy.	$33,950
Edge Drain	Lineal Foot	$15/ft.	1,060 ft.	$15,900
Topsoil (cap)	Square Yard	$6.31/sy.	7,000 sy.	$44,170
Turf Reinforcement	Square Yard	$3.50/sy.	9,080 sy.	$31,780
Turf Reinforcement (Net Free)	Square Yard	$9.00/sy.	15,125 sy.	$22,688
Seeding, Mulching, Fertilizing	Acre	$2033/acre	5 acres	$10,165
Sod Installation (includes topsoil)	Square Yard	$9/sy.	4622 sy.	$41,598
Stone Drainage Ditches	Lineal Foot	$25/ft.	1951 ft.	$48,775
Security Fence	Lineal Foot	$26/ft.	375 ft.	$9,750
15" Dia. RCP	Lineal Foot	$45/ft.	50 ft.	$2,250
12" Dia. RCP	Lineal Foot	$35/ft.	50 ft.	$1,750
Concrete Headwalls	Each	$1,200 each	4	$4,800
Air Monitoring Station	Each	$3,000 each	3	$9,000
High Volume Samples	Each	$50 each	250	$12,500

Total = $953,954
Construction QA = $95,160
Final Cost = $1,046,756

ATTACHMENT G

Tentative Construction Schedule

Pre-Final Corrective Measures Project Schedule



NOTES

1. The schedule shown does not account for Saturdays and Sundays as working days.
2. A 30-day regulatory review of the Pre-final CMD is assumed within the schedule.
3. A 30-day regulatory review of the Final CMD is assumed within the schedule.
4. A total of 90 days is assumed for receipt of Mass Earthwork, Rule 5 NPDES and Right-of-Way permits.
5. The schedule assumes a 45-day period for contracting/bidding negotiations.
6. The schedule allows for commencement of restoration activities upon completion of remediation activities within an area.
7. The schedule allows for commencement of containment cell capping activities upon completion of restoration activities within an area.

Project: Project schedule
Date: Fri 4/9/10

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline